

SCIENCE

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REMARKS ON THE PROGRESS OF CELESTIAL MECHANICS SINCE THE MIDDLE OF THE CENTURY.*

THE application of mathematics to the solution of the problems presented by the motion of the heavenly bodies has had a larger degree of success than the same application in the case of the other departments of physics. This is probably due to two causes. The principal objects to be treated in the former case are visible every clear night, consequently the questions connected with them received earlier attention; while, in the latter case, the phenomena to be discussed must oftentimes be produced by artificial means in the laboratory; and the discovery of certain classes of them, as, for instance, the property of magnetism, may justly be attributed to accident. A second cause is undoubtedly to be found in the fact that the application of quantitative reasoning to what is usually denominated as physics generally leads to a more difficult department of mathematics than in the case of the motion of the heavenly bodies. In the latter we have but one independent variable, the time; while in the former generally several are present, which makes the difference of having to integrate ordinary differential equations or those which are partial. Thus it happens that, while the

*Presidential address delivered before the American Mathematical Society, December 27, 1895, by Dr G. W. Hill.

science of astro-mechanics is started by Newton, that of thermal conductivity receives its first treatment, at the hands of Fourier, more than a century later. In addition to these two causes, ever since the discovery of the telescope the application of optical means to the discovery of whatever might be found in the heavens has always had a fascination for mankind. And, as the ability to coördinate and correlate the facts observed much enhances the enjoyment of scientific occupation, it has resulted that many who began as observers ended as mathematical astronomers. Thus our science has had relatively a large number of cultivators.

A thoroughly satisfactory history of our subject is yet to be written. We have only either slight sketches of the whole, or elaborate treatments of special divisions of the science, and none of them coming down to recent times. Among the former may be mentioned Gautier's *Essai historique sur le problème des trois corps*, which appeared in 1817. Also Laplace's historical chapters in the last volume of the *Mécanique Céleste*. Todhunter's History of the theories of attraction and the figure of the earth is an example of the latter class. Such books as Todhunter's—of which Delambre has given an earlier example in his *Histoire de l'Astronomie*—can hardly be regarded as history; they resemble rather extensive tables of contents of the literature examined, accompanied by short comments. However, in many cases, they are more useful to the student than formal histories would be, as, when judiciously compiled, they may, as epitomes in our libraries, take the place of a large mass of scientific literature. The History of Physical Astronomy, by Robert Grant, is a book that comes down to 1850, and professedly covers the whole of our subject. But only one-third of this book is devoted to astro-mechanics, the rest dealing with what is really observational and de-

scriptive astronomy. Moreover, the author indulges so much in diffuse veins of writing, that but a small fraction of the 200 pages is really given to purely historic statement. As far as the lunar theory is concerned, the third volume of M. Tisserand's *Traité de Mécanique Céleste* constitutes a fair history. But it must be borne in mind that the author's plan is to notice only the disquisitions having a first-class importance; hence his history is incomplete in this respect.

In America we are not well situated for investigations of this character, on account of the meagerness of our libraries. Of no inconsiderable number of memoirs and even books, having at least some importance in our subject, there exist no copies in the United States. Hence, should an American be inclined to undertake the task of writing the history of our subject, he must at least perform some of the work abroad.

In the present discourse it is proposed to touch very lightly the more important steps made since the middle of the century, the time at our disposal not admitting fuller treatment.

And first we will take up Delaunay's method, proposed for employment in the lunar theory, but quite readily extended to all classes of problems in dynamics. The first sketch of this method, given of course by the author himself, appeared in the *Comptes Rendus* of the Paris Academy of Sciences, in 1846. It professes to be merely an extract from a memoir offered for publication in the collections of the Academy, which must, however, have been afterwards withdrawn to make place for the two volumes of the *Théorie du Mouvement de la Lune*. When this extract is compared with the earlier chapters of the latter work, it is perceived that Delaunay has, to some extent, modified and improved his method in the interim between 1846 and 1860. In this long period nothing appeared from the author on this subject. He must have been

profoundly engaged in applying his method to the motion of the moon. Tisserand's exposition of this method is somewhat more brief than the author's own. But when the necessary modifications are introduced into Delaunay's procedures, to make them applicable to the more general case of the motion of a system of bodies, the establishment of the formulas can be rendered still more brief.

There is one point in reference to Delaunay's method which, as far as I am aware, has escaped notice. This method consists in a series of operations or transformations, in each of which the position of the moon in space is defined by six variables, the number three being doubled in order that the velocities, as well as the coordinates, may be expressed without differentials. The aim of the transformations is to make one-half of these, which Poincaré has called the linear variables, continually approach constancy, while the other half, named the angular variables, continually approach a linear function of the time. But at any stage of the process the position of the moon, as well as its velocity, is definitely fixed by the six variables produced by the last transformation, provided that the proper degree of variability is attributed to them, just as, before any transformation was made, the six elements of elliptic motion, usually denominated osculating, defined them; the point of difference to be noticed being that the more the transformations are multiplied, the more complex becomes the character of the expression of the former quantities in terms of the latter. But, however great may be the number of transformations, the series evolved have always one consistent trait, viz., that the angular variables are involved in them only through cosines or sines of linear functions of these variables, the linear functions being formed with integral coefficients. Now, as in all this work we

are obliged to employ infinite series, the question of their convergence is an extremely important one. The inquiry in this respect may be divided into two parts, mainly independent of each other. These are, convergence as respects the angular variables, and convergence as respects the linear variables. The first part is much the more simple. Regarding each of the coefficients of the series we employ as a whole, that is, representing it by a definite integral, it is quite easily perceived that the said series are both legitimate and convergent when, giving the angular variables the utmost range of values, still no two of the bodies can occupy the same point of space. In the contrary case the series are evidently divergent. This condition affords certain limiting conditions for the values of the linear variables. Could we trace these limiting conditions through all the transformations, and obtain by comparison the formulas to which these tend when the number of transformations is made infinite, we should be in possession of the conditions of stability of motion of the system of bodies. The second part of the inquiry relates to the expression of the mentioned coefficients by infinite series proceeding according to powers and products of certain parameters which are functions of the linear variables. It is well known that, in the case of elliptic elements, Laplace and Cauchy almost simultaneously showed that the series are convergent when the eccentricity does not exceed a fraction which is about two-thirds. The determination of the conditions of convergence, after certain transformations have been made in the signification of the elements, is undoubtedly a more complex problem; nevertheless, it seems to be within the competency of analysis as it exists at present.

The discovery of the criterion for the convergence of series proceeding according to powers and products of parameters is due

to Cauchy, and is a most remarkable contribution to the science of mathematics. Supposing that the parameters begin from zero values, this criterion amounts to saying that the moment the function, which the series is to represent ceases to be holomorphic, or becomes infinite, that moment the series ceases to be convergent. Consequently, if a space, having as many dimensions as there are parameters in the case, be conceived, and a surface be constructed in it formed by the consensus of all the points where the considered function ceases to be holomorphic, then, provided the values of the parameters define a point within this surface, that is, on the same side where lies the origin, the series will be convergent. Generally this surface will be closed, and, within it, the function will not take infinity as its value.

Without any mathematical reasoning the propriety of the principle just enunciated may be perceived. Since it is possible for the series in powers and products to give only one value for the function, the moment the latter may have any one of several values, the series fails to give them all; and, as there is no reason why any particular value should be selected, the conclusion must be that it does not represent any of them. Also, it is easy to see that, when the function takes infinity as its value, the series fails to represent it.

In applying this principle to the series involved in the treatment of the problem of many bodies by Delaunay's method, it appears, at first sight, as if we must have some finite representation of the coefficients in question in order to discover the particular points at which they cease to be holomorphic, such, for instance, as is given by an algebraic or transcendental equation. But this is not imperative, as it is often possible to make this discovery from certain recognized properties of the function considered, without being in possession of its form ex-

PLICITLY or implicitly. It appears probable that, in the class of cases considered, the mentioned coefficients can be represented by multiple definite integrals, all taken between the limits 0 and π , the independent variables being those which have been denominated angular. Such functions are always holomorphic, provided that the expressions under the signs of integration are themselves holomorphic between the mentioned limits. If the statement just made be admitted, although it may be impossible to write explicitly the mentioned expressions, we may, nevertheless, be certain that they remain holomorphic, provided that the linear variables, which may be the same as the parameters considered, are so restricted in their range of values that no matter what values the angular variables receive, no distance between any two bodies of the system can vanish. Or, in other words, that the R of Delaunay must never become infinite. Thus it seems probable that the conditions of convergence for Delaunay's series are precisely identical with those for the stability of motion of the system.

The series arising in Delaunay's method, as applied to the moon, contain five parameters; the number would be six were the moon's mass not neglected. We should also have six in the application of the method to two planets moving about the sun; however, should we employ the well-known function $b_5^{(1)}$ of Laplace, the number would be reduced to five. It ought to be possible, therefore, after the performance of a limited number of operations, to assign limiting values to these parameters, below which the series would certainly be convergent. This also involves the possibility of finding limits to the errors committed by truncating the series at a certain order of terms. Again, provided the time is limited to a certain interval, the capacity of these truncated series for representing the coördinates

of the planets could be shown by giving superior limits to the errors necessarily involved.

One more remark may be made before we leave Delaunay's method. In every operation or transformation half the integrals are obtained without the intervention of the time, and from these solely are obtained the ranges of values for all the linear variables. As no integrating divisors appear in their expressions, it follows that the question of stability is not affected in any way by the vanishing of these. Moreover, the presence of a libration in the angle of operation does not necessitate any change in the procedure. The integrating divisors which appear in the expressions for the angular variables, obtained through quadratures, may cause difficulty, but this can generally be removed by a modification of the parameters employed in the development of the coefficients in series. Beyond this it does not seem necessary to attend particularly to the terms which Professor Gylden has designated as critical.

To give a succinct idea of the scope of this method, it may be said that it is applicable whenever, in the system, the planets maintain their order of succession from the sun. In systems where that undergoes change, as is the case with the group of minor planets, supposing their action on each other is sensible, it is not applicable.

Delaunay's method has not yet received all the developments and applications it is susceptible of.

The treatise of Hansen on the shortest and most ready method of deriving the perturbations of the small planets was published in the interval 1857-1861. But as the principles on which it is founded had been elaborated and communicated to the public some years earlier, it is, perhaps, more properly to be assigned to the first half of the century. In consequence, I pass it over with this slight mention.

Perhaps the most conspicuous labors in our subject, during the period of time we consider, are those of Professor Gylden and M. Poincaré. We will limit our attention, for the remainder of this discourse, to the consideration of these investigations.

Professor Gylden began work with the methods of Hansen and was gradually led to modifications of them looking towards their use for indefinite lengths of time. This quality has latterly become imperative with him, and he has recently published the first volume of what is evidently intended to be a lengthy work entitled *Traité Analytique des Orbites Absolues des Huit Planètes Principales*. To show the drift of Professor Gylden's investigations, we cannot do better than give an analysis of this volume. At the outset the author introduces a class of curves he names periphlegmatic, that is, curves which surround a flame. The definition of this sort of curve is that it describes continually the space between two concentric spheres, and, at every point, turns its concavity towards the intersection of the radius vector with the inner sphere. In an application to the solar system, the sun is supposed to occupy the common center of the spheres. The investigation is at first limited to the case where this curve is plane. A differential equation of the second order is derived which the radius vector of this curve satisfies, the independent variable being the angle described. The perpendicular distance between the spheres is called the diastem. The spheres are supposed to be drawn so that they touch the curve at the points where the radius becomes a maximum or minimum. Thus, in some cases, the spheres are regarded as fixed, in others as movable. In the latter case, however, the sum of their radii is supposed to remain constant. Thence we have two groups of periphlegmatic curves; those with constant and those with variable diastems. The author gives examples of both these groups,

in most cases of which the line of apsides is variable, and considers the situation and density of the points of intersection of these curves with themselves.

The idea of an absolute orbit of a planetary body is this: an oval symmetrical with regard to an axis movable in space. While the axis remains constant in length (the half of it is called the protrometre), the velocity of its motion may vary, and the diastem may also vary. Prof. Gyldén, however, admits into the expressions of these variations only terms whose period would become infinite did the planetary masses vanish. These terms he calls elementary. But elementary terms in the diastem and the longitude of the perihelion can produce terms in the coördinates having periods which differ but little from the time of revolution of the planet. These are also called elementary terms. But the two classes are distinguished, the first as being of the type (A), and the second as of the type (B). In all the formulas relative to this matter the author insists on keeping the arc described by the radius as the independent variable.

The coördinates are only approximately given by the preceding apparatus of expressions. They must then have certain complements added to them; these, however, are all composed of terms which would vanish with the planetary masses.

In deriving the elementary terms in the radius of a planet through the integration of a linear differential equation of the second order, Prof. Gyldén attaches much price to his method of establishing the convergence of the series formed by the successive terms. As the latter are obtained through division by divisors of the order of the planetary masses, it might be feared that some of them would turn out to be very large. But the author prevents this by retaining in the coefficient of the dependent variable in the differential equation a

quantity equivalent to the sum of the squares of all the coefficients in the integral. This is named the horistic or limiting function. It is plain such an expression could be introduced in the mentioned coefficient, provided that the linear equation is the truncated form of an equation containing the cube of the variable. And in the problem of planetary motion the approximations may always be so ordered that this shall be the case.

With regard to the coördinate which exhibits the departure of the planet from a fixed plane, Prof. Gyldén does not greatly deviate from the procedure of Hansen in following the displacement of the instantaneous plane of the orbit. Only here, as in the preceding treatment of the radius, he would sharply distinguish the elementary and non-elementary terms.

At this point is introduced certain new nomenclature. As before we had diastem, now we have anastem to denote the product of the radius and the sine of the inclination; and what has generally been called the true argument of the latitude is here called the anastematic argument. Any angular magnitudes which are constantly moving through the circumference are astronomic arguments; and when they have the same mean velocity of rotation they are isokinetic; and isokinetic arguments are homorhythmic when, in each revolution through the circumference, they always retake together the same corresponding points. In like manner, the true anomaly is the diastematic argument, and we have diastematic and anastematic coefficients and moduli. It will be seen from this that Prof. Gyldén does not shrink from imposing on us the labor of learning new terms.

Thus far we have been engaged in deriving the equations of the path followed by a heavenly body; it remains to show how we may find the point on that path occupied by the body at a given moment. There is

then necessary an equation between the time and the variable assumed as independent, that is, the orbit longitude, or, more properly, the amount of angle described by the radius vector. If we suppose the absolute orbit to be described by the planet so that equal areas are passed over by the radius in equal times, it is plain that, on the attainment of a given longitude, a definite amount of time must have elapsed since the epoch. This is what Prof. Gyldén calls the *reduced* time; and he computes the difference between it and the actual time required by the theory of gravity for the planet to arrive at the stated direction. This mode of proceeding does not differ from Hansen's, except in the point that the absolute orbit is substituted for a fixed ellipse.

But this gives us correctly only the orbit longitude; for the radius and the latitude, which correspond in the absolute orbit to this reduced time, are not quite those which the planet has at the actual time. Consequently, Prof. Gyldén proposes to compute two corrections, the one to be applied to the product of the eccentricity into the cosine of the true anomaly, the other to the sine of the latitude. Also the reduction of the orbit longitude to the plane of reference must be manipulated so that it comes out correctly.

The employment of the orbit longitude as independent variable throughout all the integrations necessitates a mass of very intricate transformations of terms from one shape into another. Also the integrations which bear on elementary terms must be kept distinct from those which bear on non-elementary terms. A degree of complexity is thus imparted to the subject which makes it difficult to see when one has really gathered up all the warp and woof of it. Prof. Gyldén has nowhere removed the scaffolding from the front of his building and allowed us to see what architectural beauty it may possess; it is necessary to

compare a large number of equations scattered through the volume before one can opine how the author means to proceed.

The advantages claimed for the method are that it prevents the time from appearing outside the trigonometrical functions, and that it escapes all criticism on the score of convergence. The first is readily conceded, but many simpler methods possessing this advantage are already elaborated, and it is not so clear that the second ought to be granted.

No completely worked out example of the application of this method has yet been published. The great labor involved will naturally deter investigators from employing it.

In 1890 was published the memoir of M. H. Poincaré entitled *Sur le problème des trois corps et les équations de la dynamique*, and which obtained the prize of the King of Sweden. Most of the results of this memoir were worked over and presented anew with greater elaboration and clearness by their author in *Les Méthodes Nouvelles de la Mécanique Céleste*. Here we find a large number of new and very interesting theorems.

First is to be noted the class of particular solutions in the problem of the motion of a system of material points which are now named *periodic solutions*. The initial relative positions and velocities of the several points are so adjusted that, after the lapse of a definite time, the latter retake them. Hence is evident a method which may be employed to elaborate this special case of motion, viz., by the tentative process with mechanical quadratures. M. Poincaré has divided this sort of solutions into three classes, of which, however, the second and third are not essentially different. He has shown that, in the latter classes, the values of the arbitrary constants of the problem must be so adjusted that no secular inequalities, or, as Professor Gyldén calls them, elementary terms, may arise. The number

and variety of these particular solutions is far greater than one would at first sight imagine.

We come now to a second class of particular solutions named by the author *asymptotic*. It arises from the consideration of solutions differing very little from periodic solutions. Here we have to deal with linear differential equations having periodic coefficients. The integrals of these contain in their terms exponential factors, and on the nature of the exponents of these factors depends the quality of the resulting solutions. M. Poincaré has named these exponents *characteristic*. They are roots of an algebraic equation of a degree equal to the number of dependent variables involved in the question. If any of these roots are imaginary with real portions or wholly real, we are in presence of asymptotic solutions. The algebraic equation mentioned contains the unknown only in even powers; hence the characteristic exponents are in pairs having the same absolute value, but with contrary signs. In all the cases presented by astronomy, where, on account of the near approach to circular motion, a periodic solution can be taken as a first approximation, it appears that the squares of the characteristic exponents are all real and negative. Thus, there is no call here to consider this sort of solution, and this fact must much diminish the interest of the astronomer in it. M. Poincaré has, however, elaborated it with great pains, showing how the effect of higher powers of the deviations from the periodic solution may be taken into account. The series resulting are, nevertheless, divergent, as in other cases.

The second volume of the *Méthodes Nouvelles* is devoted to the elaboration and consideration of various processes for developing the integrals of planetary motion according to the powers of a small parameter. The chief of these are due to Professor Newcomb

and MM. Lindstedt and Bohlin; but M. Poincaré has augmented the number of them by introducing modifications of his own. All involve the principle of recurrence; that is, the first step is the only one which is independent, the following depend on all that precede. These methods, in their general aspect, do not differ from the old developments in powers of the disturbing force, except the operations are so adjusted that the time never escapes from the trigonometric functions. This is accomplished by greatly augmenting the number of the elementary arguments, and by supposing that the rate of motion of each of these is developable according to integral powers of the before-mentioned parameter, or, in some cases, of its square root.

When there is more than one elementary argument, the series obtained in all these ways are pronounced to be generally divergent in the rigorous sense of the word. M. Poincaré brings forward several methods of proof of this. The first depends on the presence of small divisors in the expressions of the coefficients. However, when we do not insist on developments in powers of a parameter, this method of proof has no application. Another method is derived from the principle that two characteristic exponents vanish for every uniform integral that exists. But the integrals which necessitate this conclusion must not only be uniform, they must be valid for every possible case of the problem. Now the integrals known as those of the conservation of living forces and of areas are of this nature; but the integrals derivable from the series of Delaunay, Newcomb and Lindstedt are valid only for a limited range in the values of the linear variables. For instance, in the problem of the three bodies, if the deformation of the triangle formed by these bodies is such that we cannot find any two sides, one of which sustains to the other an invariable relation of greater to less, we cannot apply

the mentioned series. And here it is well to note that the defect of convergence does not arise from the application of the processes of integration, but already exists in the development of the perturbative function before integration commences. Thus Delaunay's development of this function at the beginning of his lunar theory is divergent and illusory, unless we have the lunar radius in apogee always less than the solar radius in perigee, and that without regard to the mode of expressing the coefficients. Some of the particular integrals relied upon by M. Poincaré to establish the vanishing of all the characteristic exponents, in case we accept M. Lindstedt's series as valid, lie, so to speak, on the boundary of the domain in which these series are convergent.

In the third place an appeal is made to the alleged non-existence of analytic and uniform integrals beyond those already known. Were this non-existence clearly established it would decide the question on the side where M. Poincaré has placed himself. But, at least as far as the non-existence of integrals of this nature in a limited domain for the linear variables is concerned, the proof given for it is quite defective. This proof consists in ascertaining how these integrals, supposing them to exist, would behave should we attempt to derive periodic solutions from them. It is difficult to present this matter without the assistance of algebraic formulas; nevertheless, it may be attempted. Let there be a number of equations whose left members are formed by the product of two factors. When we pass to a periodic solution, one of these factors becomes zero. What conclusion can we draw from each of the thus modified equations? Evidently one of two things: either the remaining factor of the left member is infinite and the right member indeterminate, or it is finite and the right member a vanishing quantity. Now in case we are obliged to accept the first conclusion, were it only but

once, M. Poincaré has demonstrated the non-existence of integrals; but, granting that it is proper in every case to accept the latter conclusion, the demonstration fails. Now he declines to consider the latter alternative, saying that he does not believe that any problem of dynamics, presenting itself naturally, occurs where the right members of the mentioned equations would all vanish. But it should be borne in mind that, while they do not vanish in the general equations, the adjustment of the values of the linear parameters required by the passage to a periodic solution may bring about their vanishing. Thus, in the lunar theory, a periodic solution is brought about by making $e=0$, $\dot{e}=0$, and $\gamma=0$, the result is the vanishing of every coefficient having any of these quantities as a factor.

M. Poincaré appeals in another place to the fact that the Lindstedt series, if convergent, would establish the non-existence of asymptotic solutions. But this observation is irrelevant for the reason that the domains of the two things are quite distinct. In any case where Lindstedt's series are applicable there are no asymptotic solutions, and where there are asymptotic solutions Lindstedt's series would be illusory.

We owe much to M. Poincaré for having commenced the attack on this class of questions. But the mist which overhung them is not altogether dispelled; there is room for further investigation.

G. W. HILL.

ADMISSION OF AMERICAN STUDENTS TO THE FRENCH UNIVERSITIES.

THE Conseil Supérieur de l'Instruction Publique has issued a decree removing the restrictions upon the admission of American and other foreign students to the French universities and giving them a status substantially similar to that accorded by the German universities. This important concession by the French authorities is the

direct result of a vigorous movement instituted by Prof. H. J. Furber, of the University of Chicago, who in the latter part of May, 1895, addressed to the Ministry of Public Instruction a memorial, calling attention to the appreciable increase in the number of Americans engaged in post-graduate work in Europe and the vastly greater percentage of foreign students at the German universities as compared with those of France. The memorial recited that at the Sorbonne there are but 30 Americans enrolled, while some 200 are at present in attendance at the University of Berlin, and in the smaller institutions of France and Germany the disparity is even greater.

Unless it be assumed, argues Mr. Furber, that France is intellectually inferior to Germany, the indisposition on the part of American students to avail themselves of the advantages offered by the French schools would appear to indicate either a failure to appreciate the unequalled excellence of the latter in many directions, or else some obstacle preventing the enjoyment of the opportunities which they afford. It is difficult to conceive, however, that our countrymen are without knowledge of the refinement of culture for which the French schools are so justly famous, and the inference seems conclusive that the scarcity of American students in France is attributable to the difficulties which beset the foreigner in gaining admission to their courses.

In Germany an American is allowed to matriculate and qualify for a degree upon the presentation of a bachelor's degree from some reputable institution of learning in the United States, and throughout his course is at liberty to elect the studies he may desire to pursue. He is free from examination, except when he chooses to apply for a degree, preparatory to which it is incumbent upon him to submit a satisfactory thesis upon some subject of original research in which he has been personally engaged.

In fact, the only formalities required of the candidate for academic honors are the furnishing of credentials certifying to the proficiency of his early schooling, a certain minimum time spent at the universities of Germany, and a severe test of his abilities at the termination of his course.

In France, on the contrary, the student is subject to many rigorous restrictions which practically exclude the greater number of Americans. The bachelor's degree is not accepted as sufficient for entrance to many of the faculties, and the student is limited to an arbitrarily prescribed course of study and subjected to severe tests of progress at frequent intervals, depriving him in no small degree of his freedom of research and original investigation. Students from the United States are, with rare exceptions, men who have passed beyond the rudimentary grades of education and attained the rank of specialists. They are of intellectual maturity graduates of our universities and colleges, and are in quest not of discipline but of knowledge. They do not desire that any essential requirement in the French regulations be suspended, or that the grade of scholarship necessary either to matriculation or to graduation be lowered in their favor. They do insist, however, that the peculiarity of their purpose and position be duly considered, and that they be permitted to fulfill through some equivalent the requirements which, owing to the very nature of their case, are otherwise virtually prohibitive. The American student is not averse to the requirement of a somewhat lengthy term of residence in France, but he does maintain that he shall have the privilege of utilizing the period of study as he shall deem most profitable and most nearly in accordance with the plan which he has mapped out for himself.

On the 7th of June, Mons. M. Bréal, the eminent French educator and member of the Institute of France, published in the

Journal des Debats a resumé of Mr. Furber's memorial, which at once enlisted the sympathy of eminent French scholars, and resulted in a conference at the Sorbonne on the 26th of June, at which the Comité Franco-Américain was organized for the purpose of advocating before the proper authorities the desired changes in the French regulations. In July a committee styled the 'Paris-American University Committee' was also formed from among the Americans resident in Paris to coöperate with the Comité Franco-Américain, and at the invitation of Dr. Thomas W. Evans, Chairman of the Committee, a number of American and French gentlemen interested in education assembled at his residence in Paris for the purpose of deliberating upon the most practicable course to be pursued to bring about the desired reforms. Addresses were made by Mons. Bréal, Chairman of the Comité Franco-Américain, Prof. Furber and others, and the various difficulties relative to matriculation and graduation in the French universities were thoroughly discussed.

Shortly after the formation of the Paris-American Committee, Prof. Simon Newcomb, at the solicitation of Prof. Furber, organized in Washington an American committee to coöperate with the Comité Franco-Américain and to give authoritative expression of the sympathy of the people of the United States in the movement. The Committee numbers among its members Prof. Newcomb, Chairman; Dr. S. P. Langley, Secretary of the Smithsonian Institution; President Charles W. Eliot, of Harvard University; Hon. Andrew D. White; President Timothy Dwight, of Yale University; President D. C. Gilman, of Johns Hopkins University; Hon. W. T. Harris, U. S. Commissioner of Education; President Seth Low, of Columbia College; Hon. Carroll D. Wright, U. S. Commissioner of Labor; President J. B. Angell,

of the University of Michigan; President J. C. Schurman, of Cornell University; Prof. E. R. L. Gould, Secretary of the International Statistical Association; President B. L. Whitman, of Columbian University; President G. Stanley Hall, of Clark University; and G. Brown Goode, Assistant Secretary of the Smithsonian Institution, who acted as Secretary. A meeting of the Committee was held at the Columbian University on November 13th at which resolutions were adopted expressing the sense of the committee that America would heartily welcome the proposed changes in the French regulations, and suggesting, as a means of inducing American students to avail themselves of the precious advantages offered by the well-organized system of university instruction of France, that the French authorities accept the bachelor's degree as the equivalent of that of the French Lycée, and that owing to the lack of familiarity with the French language, the frequent rigorous examinations required by the French system be dispensed with in the case of foreign students. The committee strongly opposed the suggestion of establishing a degree for Americans only, which should have less significance than that conferred upon native students. These suggestions were elaborated by the French committee, presented to the Ministry of Public Instruction, and defended by the committee before the Conseil Supérieur. After due deliberation, the latter body, on the 17th of January, voted a decree introducing into the French faculties of science all the best features of the German system. In accordance with the decree, a student will hereafter be admitted to these faculties on an American bachelor's degree, and will be permitted to choose his studies. After pursuing any scientific course for a year, he can, if he wishes, apply for an examination in this branch and, if successful, obtain a *certificat d'étude*. Three such certificates

will entitle him to a *licence-ès-science*, and upon the presentation of a satisfactory thesis he will be eligible to the French doctorate. If he has the ability, he can, at his pleasure, discharge all three subjects in one year; or he can do so in successive years, migrating, if he wishes, from one university to another, and studying at the same time whatever other subject he may choose.

The French system as modified possesses one distinct advantage over that of Germany. In the latter country the student must present his thesis before he is admitted to examination for the doctor's degree, and if he fails to present a satisfactory dissertation he is without a degree or diploma. In France, however, the examination precedes the presentation of the thesis, and the student receives independent credits for every portion of his work. If he acquits himself in one branch only, he has his certificate, three of which, as has been explained, give him the *licence-ès-science*. If interrupted in his work before securing a degree he may withdraw with honorable credentials for at least that portion of his work which has been accomplished.

The degree rendered by the Conseil has reference only to the faculties of science. It is hoped, however, that a similar arrangement may be had in the Department of Letters. Important concessions have already been made in connection with the admission of American students to the faculties of medicine, and Mons. Bréal, in a letter to Prof. Furber, writes that the Faculty of Protestant Theology manifests a most liberal disposition in this regard. The changes which the French have made are of very great value. It now rests with the students of America to manifest their appreciation and to avail themselves of the facilities which are placed within their reach, in the same warm spirit in which they are offered. G. BROWN GOODE,

Secretary of the American Committee.

APPLICATION OF THE X-RAYS TO SURGERY.

THE manifold uses to which Röntgen's discovery may be applied in medicine are so obvious that it is even now questionable whether a surgeon would be morally justified in performing a certain class of operation without having first seen pictured by these rays the field of his work, a map, as it were, of the unknown country he is to explore. It may be well to consider first what has already been accomplished in this direction, and then briefly to enumerate a few achievements we may expect when the time of exposure is lessened, the intensity of this form of radiation increased and, possibly, the rays brought to a focus.

Mosetig, of Vienna, was the first to make a practical application of the new discovery in surgery. The case was one of double phalanges at the tip of the big toe. It was impossible, by the usual means of diagnosis, to decide which of these bones communicated directly with the middle phalanx, thus forming the joint, and which was the supernumerary bone. It was, therefore, deemed advisable to amputate at the distal articulation, but a picture secured by the Röntgen process revealed very clearly that one of the phalanges formed a portion of the true joint, the other being merely connected therewith by means of an osseous union. It was then a very simple matter to remove the extra phalanx, the surgeon having before him a complete picture of the osseous parts involved. The satisfaction of the patient may also be imagined, for he could see for himself the advisability and simplicity of the operation. The next case of Mosetig was one in which a bullet had lodged in the fifth carpal bone and there become encysted. Various means had been previously tried, but unsuccessfully, to locate the bullet. In the picture in this case may also be noticed a sessimoid bone; and here attention should be called to the fact that these extra bones should not be mistaken

for foreign bodies. Neusser's experiments were made upon objects outside of the body, and of these the first telegraphic newspaper reports were most confusing, many persons being lead to believe that a calculus had been photographed within a kidney in the living subject. Prof. Neusser was able to obtain a distinct picture of a phosphatic vesical calculus through four centimeters of calf's liver. Haschek and Lindenthal have shown the fibrous bands uniting old injured bones. Having injected the arteries in the hand of a cadaver, they have shown a method of making a plate which will be useful for anatomical instruction. Lannelongue, of Paris, has diagnosed by this process tuberculous arthritis. Cox, of Montreal, early in his investigations, secured the picture of a bullet in the calf of the leg; the bullet, which was afterward removed, being located between the tibia and fibula. Buckshot has been found by Pupin; needles and glass have been pictured by several observers and afterward removed. Robb, of Trinity, diagnosed a luxation and fracture in the hand of a patient who was under treatment for another condition. Röntgen has recently prepared a picture of a fracture of the forearm with much displacement. Lodge has a picture showing a bullet in the wrist. Of the tissues of a cat, Reid finds bone the most, and cartilage the least, opaque. It is reported by the *Lancet* that a thigh bone attacked with osteomyelitis has been pictured. A skiagraph of a suppressed and a rudimentary phalanx is shown in the *Boston Medical and Surgical Journal* of February 20, 1896. The writer has been able to discover in a living subject a doubling of one of the carpal bones and those of the corresponding first row of phalanges, in a case of polydactylism, with webbed fingers. The same picture also showed osseous union at the tips. In another case ankylosis of the terminal and middle phalanges of a finger is seen. And

so the list might be increased by observations made throughout the civilized world, as wherever these experiments have been repeated physicians have naturally seized upon the opportunity to benefit the patient.

Carbutt, of Philadelphia, suggests that celloidin films may be moulded to the contour of the body, thus facilitating the taking of a picture of the thicker portions of the arm, the leg, or the trunk. He is also preparing plates which will be peculiarly suitable to the action of this form of energy.

In conclusion, let me cite a few of the many instances in which this discovery may be useful in medicine and surgery. First. In the diagnosis of luxations and fractures, at times a difficult or impossible procedure, it will be possible, in certain cases, to picture a fractured bone, reduce and dress it, and afterward secure a skiagraph through the bandages, thereby demonstrating beyond doubt whether there has been proper approximation of the ends of the bones. Again, it may be practicable to fix the time at which union has taken place, and to determine accurately the amount of osseous deposit that has occurred on the bone, it being a well known fact in surgery that this union takes place in a longer or shorter time, depending upon age and individual peculiarities. The distortion of bones when pictured upon different planes might doubtless be overcome by the use of mirrors, or other apparatus.

Second. Certain foreign bodies, as glass, bullets and needles, may be diagnosed not only in the extremities, but in other parts of the body. A jackstone lodged in the larynx, or a set of teeth, penknife, coin, intubation tube, etc., in the intestinal tract might be revealed by a careful study of the plate. Renal and urinary calculi may possibly be located under favorable conditions.

Third. It may be possible to distinguish in certain cases an adulterated from unadulterated drug, *e. g.*, some tinctures permit the

rays to pass much more readily than others. Flaws in instruments, especially those made of aluminum, might be detected by these rays. Experiment alone will decide whether bacteria will be influenced by the rays in the same manner as certain colonies of organisms are injured by exposure to the direct action of the sun. Park, of New York, has exposed a culture of the diphtheria bacillus for thirty minutes to the rays from a Crookes tube without any result being noted. He who is able to secure a picture of the brain will accomplish more than can be expected from the present state of our knowledge of the X-rays.

The suggestion has been made that in our large cities skiagraphic institutions should be erected and equipped, to which physicians or surgeons could send patients, and where, under their direction, pictures of the desired portion of the body could be prepared, just as a physician now writes a prescription which is sent to the druggist to be compounded. Our large hospitals where numerous accident cases are brought should have in the near future a plant sufficient to prepare skiagraphic reproductions at short notice.

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CURRENT PROBLEMS IN PLANT MORPHOLOGY.

ON SOME CHARACTERS OF FLORAL GALLS.

THE growing interest in ecology which is so marked a feature of botanical investigation during the last five years has occasioned new and valuable work on galls, so that now for the first time compendious works have begun to appear, in which a really scientific and adequate account of these curious structures is attainable. An excellent resumé in popular style is that given in Kerner and Oliver's *Natural History of Plants*, Vol. II., pp. 518-554. That upward of 1,600 different kinds of galls have

been described is noted, and an attempt is made to classify them. With characteristic looseness Kerner divides galls into fungus galls and insect galls, but this is quite inadequate, for algæ, among plants, also produce galls, *e. g.*, *Phytophysa treubii* W. v. B.,* which attacks the leaves of *Pilea* at Buitenzorg. And "insects," under which Kerner includes Arachnoidea, are not at all the only gall-producing animals, for nematodes (afterwards mentioned by Kerner) and rotifera are well known as efficient causes in cecidiogenesis.

Kerner's classification of galls from a plant anatomical point of view is, however, excellent and is reproduced with some slight modifications in Ludwig's *Lehrbuch der Biologie der Pflanzen*.† Fundamentally galls are either simple or compound, as one or several organs take part in their production. Each class is divided into a number of subclasses, but the details need not be gone into here. The account given by Ludwig is compact and clear.

The changes produced in flowers and inflorescences when they are subjected to stimulus from a cecidiogenic organism may be classified as: 1. Chlorosis. 2. Multiplication of parts. 3. Metamorphosis of parts. 4. Suppression of parts. 5. Hypertrophy, general or restricted. 6. Antholysis. 7. Fusion of parts. 8. Fasciation. Examples of these are as follows: 1. Green flowers of *Veronica*. 2. Double flowers of *Rhododendron*. 3. Flowers of *Valerianella* in which petals are substituted for stamens. 4. Flowers of *Anemone nemorosa* inhibited by *Puccinia fusca*. 5. Flowers of *Lychnis* in which a parasitic *Ustilago* stimulates the growth of the vestigial stamens of pistillate flowers until they rival in structure the normal stamens of staminate flowers. 6. Flowers of gentians in which the carpels

* Weber: *Zoolog. Erg. Reis. Niederl. Ost-Ind.* Hft. I. 48-71. Leiden, 1890.

† Ludwig: l. c., pp. 98-110. 1895.

are separated under the stimulus of the wound. 7 and 8. Inflorescences showing both fusion and fasciation as when the Ash is attacked by *Phytoptus*.

The list of papers upon galls is a long one, including such names as De Lacaze-Duthiers, Prillieux, Courchet, Wakker, Fenzling, Frank, Massalongo, Sorauer, Frauenfeld, Loew, Kieffer, Rubsaamen, Schlechtendahl, Delpino, Thomas, Nalepa, Giard, Julin, Van Tubeuf, Magnus, Schroeter, Peyritsch and many others. A recent writer, Molliard,* has brought together in a systematic way the important facts concerning anthoecidia, and has in several instances added materially to our knowledge of the intimate changes effected in flowers by gall producers. The following is a brief resumé of his paper.

Molliard classifies anthoecidia as follows:

- I. *Phytoecidia*: Galls produced by plants.
 1. *Peronospora* galls: Produced by mildews.
 2. *Uredineous* galls: Produced by rusts.
 3. *Ustilagineous* galls: Produced by smuts.
- II. *Zoöecidia*: Galls produced by animals.
 1. *Hemiptera* galls: Produced by Aphides.
 2. *Diptera* galls: Produced by flies.
 3. *Phytoptus* galls: Produced by mites.

The galls produced in flowers of *Dipsacus pilosus* by *Peronospora violacea* show that (1) the pollen-sacs have been atrophied and the pollen mother-cells converted into parenchyma; (2) the embryo sac has been atrophied; (3) the sepals have been hypertrophied.

Knautia arvensis, attacked by the same mildew, shows (1) atrophy of the stamens, due to indirect influence, however, for the mycelium does not penetrate them; (2) atrophy of the ovules, also indirectly produced; (3) metamorphosis and hypertrophy of the corolla; (4) incomplete metamorphosis of the stamens into petals.

Matricaria inodora attacked by *Peronospora radii* shows (1) coalescences (fusions)

of pedicels and flower tubes; (2) torsion of the flower pedicels resulting from a secondary tissue which reacts against the mycelium; (3) atrophy of the sexual organs; (4) metamorphosis of ligulate into tubular flowers and antholysis of the pistil.

Molliard defines three types of *Peronospora* cecidiogenic effects:

1. The flower is not modified. Example, *P. calotheca* De By on *Sherardia*.
2. The flower is suppressed. Example, *P. arborescens* on Papaver.
3. The flower is metamorphosed and its essential functions inhibited. Example, *P. radii* on *Matricaria*.

The action of various species of *Cystopus* is summarized to show the quite different effects produced by this genus when compared with the closely related *Peronospora*. It appears that:

1. There are notable changes in the form, dimensions and contents of the individual cells of the floral organs.
2. New types of cell arrangement are produced.
3. The myrosin (in mustards) is translocated.
4. The pollen-spore mother cells are converted into vegetative cells.

The action of *Uromyces scutellatus* on the flowers of *Euphorbia cyparissias* recalls the well-known case of *Lychnis* attacked by *Ustilago antherarum*,* which is discussed anew by Molliard. In *Euphorbia cyparissias* the effect of the rust is (1) to transform the staminate flowers into pistillate or monoclinal and the monoclinal flowers into pistillate; (2) to cause atrophy of the pollen and embryo sac spores; (3) to cause hypertrophy of the parenchyma in all organs.

The most notable result of smut attacks upon flowers is the so-called parasitic cas-

* Giard and Mangin. Notes sur la castration parasitaire du *Lychnis dioica*, L.—Bull. Sc. Nat. de Fr. et Belg. II. 150; also Vuillemin: Sur les effets du parasitisme de l'*Ustilago antherarum*, Comptes Rend. Hebd. CXIII. 662, 1891, and review of this paper in Botan. Gazette. 17: 17. 1891.

* Ann. Sci. Nat. Bot. VIII., 1: 67-245. 1895.

tration, of Giard. This is known in *Lychnis dioica*, *Saponaria officinalis*, *Dianthus sinensis*, *Knautia arvensis* and *Scabiosa succisa*. Parasitic castration arises from the substitution of sterile cells or fungal spores for the ordinarily present pollen-mother cells of the stamens. It is distinguished as *indirect parasitic castration*, by Giard, from the case of *Claviceps* growing as a substitutive form and quite destroying the ovary of the rye, where the pseudomorph is said to produce direct parasitic castration.

Flowers attacked by aphides show the following characters:

1. Complete chlorosis in which all the organs of the flower assume the external and internal characters of foliage leaves (Phyllody), example, *Sinapis* and *Torilis*.

2. Complete chlorosis with hypertrophy, but the resultant structures differing from foliage leaves (Aphyllody), example, *Cerastium*, *Silene*, *Valerianella*.

The most marked characteristic of flowers converted into cecidia by gall flies is a negative one, viz: the generally slight structural change that they undergo. Hypertrophy is the principal reaction—seen well in flowers of *Raphanus*, *Sisymbrium*, *Lotus* and *Daucus*. The flowers of *Veronica* and *Cerastium* are, however, not particularly enlarged, but become concealed in a mass of cecidial leaves. The fly-cecidia of *Lychnis* and *Scabiosa* are distinguished by the formations of numerous hairs, while those of *Tanacetum* and *Spiraea* are remarkable for the general substitution of sclerenchyma for parenchyma and might be classed as *sclerotocecidia*.

Phytoptus galls are chiefly remarkable for the cytic changes which take place in them. Epidermal and hypodermal cells partake in the modification. The cytoplasm becomes highly granular, the nucleus acquires large dimensions and is highly chromatophilic. The formation of epidermal hairs is abundant and numerous modifica-

tions of the cell contents (chlorophyll, calcium oxylate, etc.) are noteworthy. Doubling, chlorosis, antholysis, atrophy and hypertrophy characterize special cases. On the whole, the Phytoptus galls in floral regions are comparable best with the Aphis galls, though differing in the greater stimulation of epidermal tracts, and the conspicuous formation of hairs which, in *Stachys betonica*, are even produced in the embryo-sac.

Moiliard's general conclusions may be readily condensed into a tabular form, as follows:

I. Modifications undergone by accessory parts of the flower.

A. Modifications of organs.

1. Accessory parts wither.

2. Accessory parts undergo metamorphosis without hypertrophy.

- a. Phyllodic metamorphosis.

- b. Aphyllodic metamorphosis.

3. Accessory parts hypertrophy.

- a. Total hypertrophy.

- b. Partial hypertrophy.

B. Modifications of tissues.

1. Simple modifications, *e. g.*, change in size of parenchyma cells.

2. Modification of cell arrangement.

3. Disappearance of tissues.

4. Appearance of new tissues.

5. Translocalization of characteristic cell contents.

II. Modifications undergone by essential organs of the flower.

1. No modification, *e. g.* *Sherardia*.

2. Inhibition of flowers.

3. Development of essential organs, but flower fails to open.

4. Modification of sporangial areas, so that sterile cells are substituted for spores. (Parasitic castration).

- a. Castration of pollen sacs.

1. Direct castration. Pollen cells digested.

2. Indirect castration. Pollen cells metamorphosed.

- b. Castration of ovules.

1. Direct castration. Ovules digested.

2. Indirect castration, where either the embryo sac fails to develop or the egg nucleus of the embryo sac fails to appear (inhibition of germination). Moiliard did not, however, discover a conversion of em-

bryo sac into parenchyma tissue coördinate with the phenomenon so common in stamens.

The synoptical resumé given above, upon examination, indicates that in general the influence of the cecidiogenic stimulus is essentially atavistic in character and results. Chlorosis, antholysis, hypertrophy, all may be considered as reversion phenomena. A peculiarly good example is the conversion in cecidia of ligulate flowers into tubular. The specialized organ becomes more generalized. It is not improbable that cecidia forms, when thoroughly understood, will be found to present a series comparable with the paleontologic or ontogenetic series of organisms, and that they will afford similar ground for speculations concerning descent, if not of species, at least of certain tissues and organs.

CONWAY MACMILLAN.

CURRENT NOTES ON ANTHROPOLOGY.

THE WALL PAINTINGS OF MITLA.

ARCHÆOLOGISTS are well aware of the mystery which has surrounded the ruins of Mitla in Oaxaca, grandiose remains which were found deserted and nigh forgotten when the Spaniards first conquered the country. A handsome large folio volume has recently been published in Berlin (A. Asher & Co.) in which Dr. Eduard Seler presents a study of the singular wall-paintings, portions of which still adorn the inner surfaces on the walls of some of the rooms.

Dr. Seler copied these with fidelity and now reproduces them with an admirable study of their meaning and origin. He is of opinion that the central figure in the religion of the Zapotecs, who are believed to have been the builders of Mitla, was Quetzalcoatl, a familiar and prominent divinity of the Nahuatl tribes. The transfer he explains by the influence which the coast branches of the Nahua exerted upon the Zapotecan priesthood. This thesis is de-

fended with a great deal of learning. Many views of the ruins are given in the full-page plates and numerous mythological figures in the text. The monograph is throughout marked by the thorough scholarship for which the author is so well known among students of American antiquity.

It is a work which our large libraries should not fail to procure.

COMMERCE ACROSS BERING STRAITS.

DR. BENJAMIN SHARP at a recent meeting of the Academy of Natural Sciences, Philadelphia, gave some suggestive information about possible ancient commerce across Bering straits. The distance is about forty miles and in the middle are the Diomed Islands, say twenty miles from each shore.

On the American side there is abundance of wood from which canoes, etc., might be made, but there is none on the Siberian side. The skin boats used by the Siberian natives, made from walrus hide, could not have been sewed sufficiently tight by bone needles to have served to cross the strait. The distance is bridged by ice about once in five years, but the passage across is considered quite dangerous, and nothing but the love of tobacco will induce a native to venture. The inhabitants of the Asian side appear to have been more influenced by the Eskimo arts than the reverse.

These facts and the general bearing of Dr. Sharp's observations are unfavorable to an extended early communication from the Siberian coast to the American.

THE SOCIETY OF AMERICANISTS OF PARIS.

FOR many years French scholars have taken a creditable interest in the study of American subjects, and another evidence in this direction is the formation of a society in Paris devoted especially to this subject. It is entitled the 'Société des Américanistes,' the president being Prof. Hamy, and

the honorary president the Duke de Loubat.

It has begun the publication of a journal in large quarto form, the first number of which has forty-one pages and several illustrations. Its contents are two articles, one by Dr. Hamy on the American collections brought together at Genoa on the occasion of the fourth centenary of the discovery of America; the second on the present state of the Fu Sang question. They are both interesting, and it is especially gratifying to see that M. Henri Cordier, the author of the latter, follows the opinion of the eminent Sinologue Professor Schlegel in wholly dismissing the discovery of Fu Sang from the list of possible pre-Columbian voyages to America. (I gave Prof. Schlegel's argument in these notes September 9, 1892).

It is not stated what relation, if any, this new society bears to the long-existent 'Société Américaine de France,' which has at times published highly valuable material.

D. G. BRINTON.

SCIENTIFIC NOTES AND NEWS.

A DIRECTOR IN CHIEF OF SCIENTIFIC BUREAUS IN THE DEPARTMENT OF AGRICULTURE.

A LARGE number of letters have been addressed to Senator Redfield Proctor, Chairman of the Committee on Agriculture, urging the appointment of a permanent Director in Chief of the scientific bureaus and investigations under the charge of the United States Department of Agriculture. The writers of the letters include the presidents and members of the faculties of Johns Hopkins University and of Yale University, the president of Columbia University, Professors Brewster, Shaler and others most competent to judge of the importance of this measure.

The Joint Commission of the Scientific Societies of Washington has adopted the following resolutions:

WHEREAS, The work of the Department of Agriculture in the discovery, exploration, development, conservation and proper utilization

of the resources of our country is of the utmost importance; and whereas the Department's capacity for originating, procuring and disseminating knowledge of vital importance to farming and other interests, though already large, is capable of much extension in the future; and whereas the results accomplished through the system now in existence have been exceedingly great, and the one thing above all others necessary to increase the efficiency of this organization is a permanent policy with regard to its work and personnel:

Resolved, That the Joint Commission of the Scientific Societies of Washington, composed of the officers of the several scientific societies of the city, comprising in all a membership of nearly 2,000, heartily approves the proposition to create the office of 'Director-in-Chief of Scientific Divisions in the Department of Agriculture,' to be filled by a broadly educated and experienced scientific administrative officer, holding office during good behavior.

Resolved, That the plan of having a permanent officer in charge of the scientific and technical work under the executive head of a department represents a distinct advance in good government, and is therefore not only of national importance, but if carried out certain to have a beneficial effect upon the scientific standing of Government work in all its relations.

RÖNTGEN RAYS AND THE ROYAL SOCIETY.

THE London papers give the following account of the meeting of the Royal Society on February 13th: A paper by Lord Kelvin on The Generation of Longitudinal Waves in Ether described an arrangement for obtaining pressural disturbance through a considerable space of air, accompanied by a very small proportion of ordinary transverse waves. His apparatus would afford the means of exposing sensitive plates to these longitudinal vibrations, and thus might assist in elucidating the nature of the Röntgen rays. A paper by Prof. J. J. Thomson was also read relating to experiments from which he concludes that all substances when transmitting the Röntgen rays are conductors of electricity. A discussion followed the reading of these papers, in which de-

tails were given of many experiments on these X-rays. Its general effect was, however, to show that, while many interesting points have been noted, the obscurity hanging over the subject had not been appreciably lightened. Considerable differences of opinion were manifest even upon the conditions of the Röntgen experiments. While some advocated the use of very powerful currents, others had been successful with relatively weak ones; and while some were in favor of regarding the phosphorescence of the glass as the efficient source of the rays, others ascribed them to the glow of the electrodes. A new turn was given to the discussion by Captain Abney, who ventured, amid some expressions of dissent, to doubt whether the action of the Röntgen rays on a sensitive plate could properly be described as photographic. He cited several facts which, in his opinion, excluded the theory of direct photographic action in any ordinary sense, and indicated some preference for the view that the Röntgen rays acted by first setting up phosphorescence or action of some unknown kind in the glass at the back of the sensitive film. This view was corroborated by an experiment described by Prof. Dewar upon platino-cyanide of ammonium at low temperatures. This salt, ordinarily fluorescent, only became phosphorescent at the temperature of liquid air. On being exposed to Röntgen rays, instead of the ordinary light, while immersed in liquid air, it showed when the liquid air was poured off brilliant phosphorescence. This proved that whatever might be the nature of the Röntgen rays, they were convertible into the light rays affecting the human eye. A large number of experiments were also described by Prof. Dewar showing that resistance to the passage of Röntgen rays increased with increase of atomic weight. Organic substances were all relatively transparent, following the carbon, oxygen, hydrogen and nitrogen of which they are composed. Mere complexity of structure made no difference, but substitution products showed increasing opacity in the order of the atomic weights of the combined chlorine, bromine and iodine.

ASTRONOMY.

THE January number of the monthly notices

of the Royal Astronomical Society contains a very interesting article by Messrs. Christie and Dyson upon the progress of work on the Astrophotographic Catalogue at Greenwich Observatory. It appears that up to the present time no less than 160 plates for the Catalogue have been measured. Moreover, at the present rate of progress 180 plates are being measured annually, and it is estimated that only five or six years will be required to finish the Greenwich zone. The precision of the Greenwich measures is not quite as great as it might be, however, because the authorities there prefer to sacrifice some accuracy in order to expedite the progress of the work. We venture to doubt whether this course is to be commended. It is hardly in accord with the best traditions of the Greenwich Observatory. Probably twelve years devoted to this work, instead of six, would have been sufficient to extract the very highest accuracy possible from these photographic measures.

PROF. ALBRECHT, of Potsdam, has now published in the *Astronomische Nachrichten* the results of his researches on the Variation of Latitude, to which we made reference in a recent number. The former publication took place in the report of the proceedings of the International Geodetic Committee, which is not very accessible to the general astronomical public.

H. J.

GENERAL.

WE much regret to learn that the *American Meteorological Journal* will be discontinued after the forthcoming April number, which ends the twelfth volume. The *Journal* has been carried on at a financial loss on the part of the editors ever since its foundation in 1884, and the present step has been decided upon because there seems no hope that it will become self-supporting, and because the editors do not wish any longer to be financially responsible for a magazine that has not secured the support which it seems to them to have deserved.

THE series of the *Catalogue of Scientific Papers* of the Royal Society, covering the years 1874-83, has been completed by the publication of Vol. XI.

AT a meeting of the Royal Photographic

Society on February 13th it was mentioned that as bearing on the suggestion that the Röntgen rays might resemble ultra-violet rays in possessing germicidal effects, that a cultivation of diphtheria microbes had been subjected to their influence for 12 hours without any sterilizing results.

THE Senate committee on appropriations has concluded its consideration of the agricultural appropriation bill increasing it in the aggregate to the extent of \$47,260, and making a total appropriation of \$3,262,652. The principal increase is \$40,000 for the publication of the special report on the diseases and the feeding of cattle, and the principal reduction is \$9,000 on the appropriation of \$15,000 made by the House for an investigation of irrigation.

THE Odessa correspondent of the *London Times* writes that the Russian government will send a special scientific mission to observe the total eclipse of the sun which occurs on August 9th. It is remarkable that this total eclipse will be almost exclusively visible throughout the northern part of the Russian Empire, as the line of totality passes from the extreme north of Norway, over Novaya Zemlya, Siberia and Manchuria, to Jesso, in Japan. The mission will be in charge of three astronomers from the Nikolas Observatory at Pulkoff, and leaves Odessa in May by one of the cruisers belonging to the Russian Volunteer Fleet Committee for Vladivostok, whence it will go near the mouth of the river Amoor for observations. The committee has agreed with the government to convey the mission from Odessa to Vladivostok and back again to Odessa free of charge.

DR. LAUGHTON McFARLANE, professor of surgery at the University of Toronto, died on February 29th, from blood poisoning, contracted while amputating the toes of a patient at the General Hospital a week ago. He was 54 years old.

THE London correspondent of the *New York Sun* states that an Antarctic expedition has been arranged for next winter. It will be partly a trading and a scientific enterprise, and will be under the command of Capt. Svend Foyn, of Christiania. Mr. W. S. Bruce, of the Ben Nevis Observatory, will have charge of the sci-

entific party, composed of himself and four other men. The scientific party will be landed on the Antarctic continent in Victoria Land in January next, and the vessel will then engage in whale and seal fishing, returning to Australia. The following season, in January, 1898, she will return and take off the scientific party, who hope by then to have obtained knowledge of the fauna, flora, geology and topography of the Antarctic region. If found practicable, an attempt will be made to reach the south magnetic pole.

THE Secretary of the Treasury has sent to the Senate the report of Mr. Joseph Murray, a special agent, who has spent seven seasons on the seal islands of Alaska. He states that in 1894, the first year the Paris regulations were in force, 142,000 seals were killed, of which number 60 per cent. were female, all of which left pups to die on the island of starvation. He claims that there were at the close of that season, by the most liberal estimate, not more than 300,000 seals on the islands, whereas when he first went there, in 1888, there were fully 3,000,000.

DR. SELLE and Dr. Neuhauss have exhibited in Berlin colored photographs which have attracted much attention. They are said to be taken by the method used by Mr. Joly of Dublin, three specially prepared plates appropriate for green, red and blue lights respectively being used. The process has been simplified and the time of exposure shortened. Mr. Frederick Ives exhibited before the Royal Photographic Society of London, on February 25th, his stereopticon showing colored pictures.

PROF. ROBERTS-AUSTEN was announced to deliver the Bakerian Lecture before the Royal Society, on February 20th, his subject being the 'Diffusion of Metals.' *Nature* states that Prof. Roberts-Austen has obtained some singular experimental results connected with the mobility of solid metals. Many experimenters in England, especially Prof. Graham and Lord Kelvin, have studied the diffusion of gases and saline solutions, and Prof. Roberts-Austen measured the rate at which certain metals will penetrate each other. He finds that solid gold, for instance, will diffuse into and move about slowly in lead, even at the ordinary tempera-

ture of the air, and with considerable rapidity if the lead be warmed, though far from melted. Evidence as to the presence of wandering atoms in a solid possesses much interest now that views as to the nature of metals and other solids have been extended by the discovery that certain rays of light will penetrate them.

THE Postmaster-General has modified the order forbidding the use of the mails for the transmission of specimen germs of cholera or other diseased tissues. By special permit and in mailing packages constructed in accordance with special specifications such germs may be transmitted to United States or municipal laboratories.

ACCORDING to the Boston *Transcript* Mr. Charles B. Cary, curator of the ornithological department of the Field Columbian Museum, has established at Palm Beach, Florida, a museum devoted to the natural history of the State, which is soon to be opened to the public. An excellent collection of birds, reptiles, mammals, fishes, etc., is already in order, and aquaria are to be fitted up for the study of salt and fresh water fishes.

A DEPUTATION has appeared before Mr. Chaplin at the House of Commons to urge that the present English legislation, which practically prohibits the use of self-propelled wagons, be repealed. Mr. Chaplin said that he was in full sympathy with the movement represented by the deputation. A bill was now being prepared by the Local Government Board, and he hoped, with the assistance of Mr. Russell, to carry it without opposition through the House this session.

THE March number of McClure's Magazine contains an article on scientific kite flying by Mr. Cleveland Moffett, describing with illustrations the experiments made by Mr. Eddy.

BY the courtesy of those in charge of the exhibit of the Plant System at Atlanta, the United States National museum has obtained a number of fossils from the Peace Creek phosphate deposit. The greater part of these, including some well preserved teeth, are remains of the mammoth *Elephas primigenius colombi*, and are interesting as showing the large average size of the Florida mammoth. Among the smaller

specimens is a fine metacarpus and molar of *Bison latifrons*, the former indicating an animal a trifle over six feet high at the shoulder, about nine inches taller than *Bison americanus*. Two molars of a species of *Procamelus* are probably referable to *Anchenia minimus* of Leidy and are the first of this species that have come to light.

A RECENT paper by Dr. Gustav Hartlaub, issued as a reprint from *Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen* treats of birds which have recently become extinct or whose numbers have been so reduced that the species seems threatened with extinction. Twenty-three are placed in the first category and twenty in the second, although some of these, like *Notornis mantelli*, are practically extinct. Man and his familiars, cats, rats and hogs, are directly responsible for most of the destruction; and Dr. Hartlaub, in an introductory chapter, treats of the various ways in which it is brought about. References to the more important literature on the species discussed, and a statement of the institutions in which the rarer species are preserved, make the paper particularly valuable to the ornithologist.

Dr. LEIDY's delayed posthumous memoir on fossil vertebrates from the Alachua clays of Florida is now in press, and will appear as a part of the transactions of the Wagner Free Institute of Science.

A NEW monthly journal of entomology has appeared in Tokyo, Japan, under the title *Konchū Gaku Zasshi*, or Journal of Insect Science. The first number was issued in October last, and is wholly in Japanese, excepting an English title and the statement that the plate represents insects injurious to rice and mulberry.

WILHELM ENGELMANN, Leipzig, announces the early publication of a *Grundriss der Psychologie* by Prof. W. Wundt. The book is awaited with much interest, and should be translated into English without delay. Prof. Wundt is by common consent the preëminent representative of modern psychology. His *Menschen und Thierseele*, published more than thirty years ago, defined the course that psychology has since

followed, and his *Grundzüge der physiologischen Psychologie* (Fourth Edition, 1893) is the standard compendium. The volume of Prof. Wundt's writings is almost as remarkable as is their value. He has published large works on physiology, physics, logic, ethics and philosophy, and has in preparation a treatise on anthropological and sociological psychology.

PROF. WUNDT established, in 1883, an *Archiv Philosophische Studien* for the publication of researches in philosophy and psychology, which is now in its twelfth volume. Last year Prof. E. Kraepelin, of Heidelberg, established a similar archiv and now a third archiv, *Beiträge zur Psychologie und Philosophie* has been begun by Prof. Götz Martius, of Bonn. The first number of the first volume contains a preface and an introduction by the editor and four papers all concerned with the brightness of colors. It may also be mentioned that Prof. Münsterberg has published his contributions to psychology in the form of *Beiträge*, and that there is in Germany an excellent *Zeitschrift für Psychologie u. Physiologie der Sinnesorgane*, edited by Prof. Ebbinghaus, of Breslau, and Prof. König, of Berlin. Ten large volumes of this journal have been issued since its establishment in 1890. These contain full reviews of psychological literature and many important papers, those on vision being probably of greater value than all the papers combined that have been published elsewhere on this subject.

THE number of the *Zeitschrift für Psychologie* issued on January 14th contains an index of psychological literature for the year 1894. The index appears somewhat late, but is very complete, especially in regard to publications on the senses. The *Psychological Review* issued, at the beginning of February, a supplement containing a bibliography of the literature of psychology for 1895, compiled by Dr. Livingston Farrand, of Columbia University, and Prof. Howard C. Warren, of Princeton University. The index contains 1394 titles, distributed as follows: General, 136; genetic, comparative and individual psychology, 238; anatomy and physiology of the nervous system, 205; sensation, 125; consciousness, attention and intellect, 180; feeling, 91; movements and vo-

lition, 81; abnormal and pathological, 338. This index is also about to be issued in France as part of *L'Année Psychologique*, edited by MM. Beaunis and Binet.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

TO THE EDITOR OF SCIENCE: In your issue of February 21, in an interesting paper on 'Certitudes and Illusions,' Major J. W. Powell has repeatedly referred to an illusion which he describes as a certain tendency to 'reify void'—an ancient, and, as Major Powell has very well said, a disastrous tendency of the human mind. This is the tendency to recognize mere abstractions as realities, and, in consequence, to explain phenomena by referring their source to 'essences' or to some sort of 'substrate,' defined as 'some occult existence unknown and unknowable, which gives to bodies their likeness or unlikeness.' Major Powell very justly condemns this tendency, exemplifies it in a number of cases, suggests explanations for its existence, and rightly declares its inevitable outcome to be a bad metaphysic. So far the present writer cordially agrees with Major Powell.

But, as a humble student of the history of philosophy, the present writer is very sorry to find that Major Powell, influenced by some singular historical 'illusion,' repeatedly refers to one of the best known of modern thinkers, Hegel, as a prominent example of precisely this sort of bad metaphysic. "As the substrate of matter, or reified nothing, is entertained in the minds of some as an entity, so some thinkers make essence a property of this substrate—a nonentity of a nonentity. Chuar (Major Powell's entertaining Indian friend), Hegel, and Spencer reason in this manner."

Major Powell is no doubt an absolute authority as to the views of his Indian friend, and he appears in this particular case to be in no wise unfair to Spencer. But to put Hegel in the same category, to define that lifelong opponent of the 'unknowable,' that merciless dialectical dissolver of all the 'essences,' 'substrata,' and similar entities of traditional metaphysic, as one who, at least in *this* sense,

'reified the void,' well, from the point of view of the student of the history of philosophy such a way of assailing Hegel is in its accuracy similar to a way of assailing Luther's theological views which should hold the reformer up to scorn as a defender of the wicked doctrine of 'justification by works,' and as a blasphemous opponent of 'justification by faith.' One might want to condemn Luther's views; but it would hardly be accurate to talk of 'Luther and the other Papists.' And even so, one is welcome to regard Hegel as a mischievous thinker; but one must not give as a reason that one classes him with those other believers in 'an occult, unknown and unknowable substrate.'

As a fact, by no means all, but certainly a number of Major Powell's own assertions in this valuable paper are theses which every student of Hegel knows to be defended with great energy by the latter thinker. Major Powell well says: "What is the meaning of the word *this*? It may be applied to any constituent of matter, to matter itself, to any body or to any property, and to any idea in the mental world, and its meaning is derived from the context; it has no definite meaning in itself." This is a part of the thesis of Hegel's famous opening chapter of the 'Phänomenologie des Geistes.' And of this thesis in the sequel Hegel makes a use closely analogous to Major Powell's. That to make essence an abstract 'property' of 'the substrate of matter,' is to make essence a 'nonentity of a nonentity' is a thesis so repeatedly maintained by Hegel, in his 'Phänomenologie' (in the third chapter on 'Kraft und Verstand'), in his larger Logic in the second volume, where this 'Bewegung von Nichts durch Nichts zu Nichts' is elaborately discussed, and elsewhere, that Major Powell's failure to recognize the relation of Hegel to this thesis can only be due to a failure to study the habits of Hegel, as our anthropologist would prefer to study those of Chuar, namely, in the 'native wilds' of the thinker himself. The Hegel of whom Major Powell speaks is a product of somebody's 'inner consciousness' and, whoever may be responsible for the dream, all the 'eloquence of the dreamer' cannot make this Hegel an historical person.

Of course, one must beg pardon for laying so

much stress upon the mere accidental fact of history in a case like this. Major Powell's general philosophical construction in this paper seems to the present writer despite some minor doubts, essentially sound, and admirably stated. But, as Major Powell himself obviously holds, the history of philosophy is, at least in one aspect, an anthropological study. It is undesirable that even a minor error should, through a chance misstatement, stand upon record as receiving the support of so eminent an anthropological authority as Major Powell.

JOSIAH ROYCE.

CAMBRIDGE, MASS., February 22, 1896.

PROF. C. LLOYD MORGAN ON INSTINCT.

EDITOR SCIENCE: In an account of a discussion on instinct given in SCIENCE of February 14th, Prof. Morgan is reported thus: "He described his own interesting experiments with chicks and ducklings, and held that these and other evidence tend to show that instincts are not perfected under the guidance of intelligence and then inherited. A chick will peck instinctively at food, but must be *taught to drink*. [Italics mine.] Chicks have learned to drink for countless generations, but the acquired action has not become instinctive."

In one of a series of papers now in the press on 'The Psychic Development of Young Animals and its Physical Correlation,' I have given in detail an account of a study of the pigeon and the chick. It so happens that this very question of drinking by chicks has been especially noted, and I find a record of one observation to the effect that a newly hatched chick pecking at the drops on rim of a vessel containing water accidentally got its beak into the liquid, whereupon it at once raised its head and drank perfectly well in the usual fashion for fowls. Was this by teaching or by instinct?

Later the chicks seem to peck and drink, sometimes on seeing the mother do so. The act seems to be in such a case a sort of imitation so far as its inception is concerned. But will any one contend that that first act of drinking referred to above was other than instinctive? Again, when a chick first drinks on its beak being put into water, can the act be considered as the result of teaching? Is the

chick so intelligent as to carry out an act so complex in such a perfect way as it does on the very first occasion as the result of 'teaching?' Surely no one will deny that sucking is an instinctive act, yet a newly born mammal sucks only when its lips come *in contact* with the teat. Is not the case very similar with the chick? The only difference is that the chick is slower to *recognize* water than food, but as soon as the beak touches water it drinks and there is no teaching about it. Considering how seldom a fowl drinks, yet pecks all day long at particles of food, it is not surprising that the chick is slower to recognize water (drink) than food. But it is one thing to say that a chick learns to recognize drink and another to affirm that it learns to drink. The process of drinking is quite as perfect as that of eating from the very first, if not more so, for a chick at first often misses what it pecks at and fails to convey the object into its mouth in other cases, though it may touch it.

The view that instincts are perfect from the first and undergo no development from experience, I believe, after much observation, to be as erroneous as it is ancient.

Instinct is never, perhaps, perfect at first, and so far as I can see, could not be owing to general imperfect development in the animal of motor power, the senses, etc. A young puppy will suck anything almost that can pass between his lips, as a chick will peck at any light spot or object if small, be it food or not. My own records abound in observations that amply prove the position taken, and while my experiments and observations on birds are in the main in accord with those of Prof. Morgan so far as I know them, I cannot but believe, if I have correctly understood his views as reported at the New York meeting, that he has misconceived or overstated the case under consideration.

The subject of heredity is too large to enter upon now. I may say, however, that my researches in comparative psychology and especially in that part bearing perhaps most closely on the question, psychogenesis, do not incline me to believe any the more in that biological *ignis fatuus*—Weismannism.

WESLEY MILLS.

MCGILL UNIVERSITY, MONTREAL.

[Professor Morgan's observations agree with those of Professor Mills and others. A chick swallows water instinctively, but must be taught to drink by example or by accident. The chick might die of thirst in the presence of water, as the sight of the water does not call up the movements of pecking at it, as do food and other small objects. The mother hen replaces natural selection, and the action, though continually practiced by the individual, has not become instinctive, because it has not a selective value. Professor Morgan's argument seems to be satisfactory. If actions which occur but once in the lifetime of the individual (*e. g.*, the nuptial flight of the queen bee) are thoroughly instinctive, and others which are practiced continually by the individual do not become instinctive in the race, we can scarcely regard instincts as hereditary habits, but must rather attribute them to variations, fortuitous or due to unknown causes, and preserved by natural selection.—THE WRITER OF THE NOTE.]

THE CHANCE OF OBSERVING THE TOTAL SOLAR ECLIPSE IN NORWAY.

EDITOR OF SCIENCE: As unusual facilities are being offered to visit northern Norway to observe the total solar eclipse on the 9th of next August, of which many American and English astronomers and tourists will doubtless take advantage, it seems desirable to make known the following data relating to the cloudiness, and the consequent probability of seeing the eclipse there. They have been communicated to me by Prof. H. Mohn, director of the Norwegian Meteorological Institute, who prepared them for the Swedish Astronomical Association.

Vadsö, which has been recommended as the most accessible station near the central line of totality and will be the rendezvous of several parties, is situated in Latitude 69° 52' North and Longitude 29° 45' East of Greenwich. According to the British Nautical Almanac, the total phase, lasting 1m 47s, here occurs at 15h 58m Greenwich time, or 5h 55m local mean time, which is 2 hours after sunrise. The sun's altitude is 15°.

Professor Mohn writes: For Sydvaranger, the nearest place to Vadsö at which meteorological observations have been made, the amount

of cloud on a scale of 0 to 10, and the chance in percentages of its occurrence are as follows :

August 8th, 8 P. M.		August 9th, 8 A. M.	
Amount of Cloud.	Chance.	Amount of Cloud.	Chance.
10	45.5	10	45.5
8	13.7	9	9.1
7	4.6	8	4.6
5	4.5	7	9.1
3	9.1	6	4.5
2	4.5	4	4.6
0	18.2	3	4.5
		2	9.1
		0	9.1
100.1		100.1	

"In Vadsö there is a telegraph station, and time signals are to be had from the observatory in Christiania. The latitude and longitude have been determined with all possible accuracy. Sydvaranger lies on the south side of the Varangerfjord and Elvenes is the name of the posting station. Vardo, lying on the north side, is not to be recommended, having too often fog or clouded sky. In the interior of Finmarken the sun is lower than at Varangerfjord."

Although the astronomical conditions of low altitude of sun and short totality are not good, yet the meteorological conditions just noted compare favorably with those of stations in Japan, where the eclipse occurs later in the day and totality lasts longer. As a basis of comparison for the chance of clear weather, it may be stated that here at Blue Hill, Mass., near the coast, at 8 A. M. in August the average frequency of cloudy weather (sky 8 to 10 tenths covered) is 50.0 per cent. and the average frequency of clear weather (sky 0 to 2 tenths covered) is 32.3 per cent.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY, February 20, 1896.

THE RÖNTGEN RAYS.

The following fact regarding the X-rays of Röntgen may be of interest:

I have found that it is possible to obtain a photographic image by these rays using a 'pin-hole camera,' having the aperture pierced in a piece of sheet lead backed with aluminum. The Crookes tube was illuminated by discharges from a Thomson high-frequency coil. The

photographs taken in this way show very distinctly the two electrodes, while the glass bulb, which appeared to be brightly illuminated to the eye, is scarcely perceptible. It would appear from this that nearly, if not all, the so-called X-rays proceed directly from the electrodes of the tube and not from the glass where this is acted on by the cathode-rays. It likewise affords further illustration of the rectilinear motion of the X-rays. Experiments are in progress with a broken current and also to study the effect of a magnetic field.

Previous observation had shown that the photographic effects were produced equally whether the cathode rays impinged upon the glass or upon other phosphorescent material (e. g., arragonite) within the tube. It has also been noticed in experiments in this laboratory that the appearance of the tube to the eye affords no criterion of its efficiency in producing the X-rays; tubes showing but little fluorescence of the glass composing them often giving admirable photographic effects, which in some cases are obtainable even from a low-vacuum Geissler tube. But the rays producing photographic effects always appear to produce strong fluorescent effects on platino-cyanide of barium, so that the fluorescence of this affords an indication of the photographic efficiency of the radiations emitted from the tube.

RALPH R. LAWRENCE.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
BOSTON, February 26, 1896.

RÖNTGEN RAYS PRESENT IN SUNLIGHT.

IN the course of a series of experiments on the so-called Röntgen or X-rays, the undersigned have secured evidence of the presence of these rays in sunlight, and have been able to reproduce many of the phenomena ascribed to the X-rays, without the use of vacuum tubes or any other source of light or energy than direct sunlight.

Dr. Egbert was led on February 22d to place in a photographer's printing frame, an ordinary sensitive plate (Seed's No. 26), upon which was superimposed a positive lantern slide, and on this a shield of aluminium; which was then exposed to the direct rays of the sun for two hours, and the plate developed, when it was found that the aluminium shield had been transparent

to some agent which had produced a photographic effect; although the sensitive plate was completely in the dark within the printing frame and thoroughly protected from light rays as generally understood. Apparently, however, the plate had been over-exposed, and it seemed that better results might be obtained by shorter exposures. Therefore other plates of the same kind were exposed by us for gradually decreasing periods, under negatives and positives, and shields, respectively of aluminium, hard rubber, black cardboard and double thicknesses of opaque needle paper.

Positives were obtained in each case resembling those obtained by the photographer with ordinary methods, in some cases the exposures being as brief as ten minutes.

Shadowgraphs ('skotographs,' or 'skia-graphs') were also produced by the method employed by Prof. Röntgen, except that the source of energy was the direct sunlight in place of the rays from a vacuum tube, *i. e.*, coins placed upon the aluminium shield produced shadow prints on the sensitive plate.

It is obvious that these experiments prove the presence in sunlight of the peculiar rays described by Prof. Röntgen, or of others possessing the same properties, namely, the power of penetrating substances opaque to ordinary light rays.

Prof. Röntgen states, in the second clause of his article (as translated and printed in *SCIENCE* of February 14th, p. 227,) 'that some agent is capable of penetrating black cardboard, which is quite opaque to ultra-violet light, sunlight or arc-light.' If this statement refers to sunlight *in toto*, including the visible and invisible rays, it is evidently contravened by our experiments, which demonstrate beyond a doubt the existence of an 'agent' in sunlight, which accomplishes the work of the 'X-rays.'

Prof. Röntgen refers to the possibility that the effect is due to a fluorescence produced in the material of the sensitive plate. One of our experiments seemed to point to the correctness of this hypothesis. Fixed photographic prints on albumin paper placed between the aluminium shield and the sensitive plate gave corresponding negative effects; but the space covered by these prints was evidently more in-

tensely acted upon by the rays than other parts of the plate covered only by the aluminium. Should fluorescence be produced by these rays in silver emulsions, it would perhaps explain the phenomena. Prof. Röntgen further states that silver in 'thin' layers allows the rays to pass; but we have shown that some of the rays are partially stopped by the exceedingly thin film of silver in the ordinary photographic negative.

It is obvious that the discovery of these rays in sunlight opens up an entirely new field for experiment and is of the highest practical importance to all photographers.

We hope to supplement this preliminary statement by a presentation of the results of our attempts to solve a number of interesting problems that have been suggested.

CHARLES S. DOLLEY,
SENECA EGBERT.

[Results somewhat similar to those given by Drs. Dolley and Egbert have been announced by M. Gustav Le Bon, Prof. S. P. Thompson and others. The conditions, are, however, so complex that it is difficult to eliminate sources of energy other than the Röntgen rays. Careful experiments at Columbia College have not detected any penetration of thin ($\frac{1}{16}$ inch) sheets of aluminium by sunlight, though ebonite and wood of considerable thickness are penetrated by ordinary light. Ed].

RÖNTGEN RAYS FROM THE ELECTRIC ARC.

PROF. S. P. THOMPSON is reported* to have discovered the Röntgen rays in the radiations emitted by the electric arc, and to have succeeded in getting excellent shadow pictures with them. The present writer had carried out the following experiments before seeing the report of S. P. Thompson's work, and had reached conclusions opposite to those reported of Prof. Thompson.

Very rapid (Carbutt's 'Eclipse 27') and medium (Carbutt's 'Orthochromatic 23') plates, placed in ordinary holders, were laid in deep lead trays and masked with two to five thicknesses of black cardboard, including the card-

* London, *Electrician*, January 24, 1896. Digest in the *Electrical World* February 15th.

board slide of the plateholder. Bits of sheet aluminum ($\frac{1}{4}$ mm. thick) and of sheet lead ($\frac{1}{4}$ mm. thick) were laid upon the cardboard slide of the plateholder. Two to five hours' exposure to a 900 Watt arc at a distance of 25 cm. produced no perceptible effect.

The bits of sheet metal were then for convenience placed next to the gelatine film and the plates, masked with two thickness of black cardboard, were exposed to the arc for three hours at a distance of about 12cm. The plates become quite hot, about 80°C. after development the action was found to be quite strong where the plate was not screened by the bits of metal. The bits of metal, each several square centimeters in area, screened the plates about equally. The portions of the films under the bits of metal showed very faintly the texture of metal surface, as if by reflection.

The plates were then arranged so as to obviate excessive heating by ventilation, and masked with two thicknesses of black cardboard and two to four thicknesses of mask paper, the bits of sheet metal being placed outside the cardboard slide of the plate holder as at first. Three hours' exposure at a distance of 15 cm. from the arc produced no perceptible effect.

The arc was then arranged to play between zinc and carbon, taking about ten amperes at thirty-five volts. The plates arranged as described in the previous paragraph were exposed to this zinc arc for two hours at a distance of about ten centimeters. The zinc rod was cathode for about one hour and anode for about one hour. No perceptible effect was produced.

It seems justifiable to conclude from these experiments that Röntgen rays are not given off in any abundance by the electric arc, and that they are not of the same nature as the ultra-violet of the spectrum, or at least that they are not of the same nature as the ultra-violet, which is present in any abundance in the light emitted by the electric arc between carbon electrodes or between zinc electrodes.

In demonstrating the presence of Röntgen rays it is necessary in every case to exercise the greatest care in the rigid exclusion of every other agent capable of affecting the sensitive plate, such as ordinary and ultra-violet light,

electric charge acting directly upon the film, mechanical pressure, high temperature, etc. These rays and the cathode rays are distinguished among all other actinic radiations by the facility with which they pass through metals and from each other by their different behavior in the magnetic field, as appears from Röntgen's paper.

W. S. FRANKLIN.

AMES, IOWA.

SCIENTIFIC LITERATURE.

Grundzüge der Marinen Tiergeographie. Anleitung zur Untersuchung der geographischen Verbreitung Mariner Tiere mit besonderer Berücksichtigung der Dekapodenkrebse. Von DR. ARNOLD E. ORTMANN, in Princeton, N. J., U. S. A. Mit 1 Karte. Jena, Verlag von Gustav Fischer. 1896. Pp. 96. M. 2.50.

This is an excellent contribution to zoögeography, which ought to be in the hands of everybody interested in the fascinating questions of animal distribution. A great number of highly interesting points are also discussed, important for the biologist and geologist.

The principal aim of this work, the author states in the introduction, is to call the attention of the scientific world to the highly interesting study of the distribution of marine animals hitherto greatly neglected. Before all, the principles had to be established, according to which the distribution of marine animals has to be examined; in doing so it was necessary to discuss the general principles of animal distribution. Since the question of the distribution of species is most intimately connected with that of their origin the latter had to be examined, and the result is reached that the principle of separation or isolation is one of the most important factors. As an example of distribution Dr. Ortmann selected the group of decapod crustaceans, of which he has made special studies. He finishes his introductory remarks with the very pertinent sentence that without extensive and critical systematic preliminary work fruitful geographical studies are absolutely impossible.

The work is divided into seven chapters. The first chapter gives an historical review of the development of zoögeographical science. He distinguishes three periods.

1st period. The oldest attempts of A. Wagner, L. Agassiz, Dana and Schmarda.

2d period. To A. Agassiz and Wallace. The period of the discussion about the number of zoögeographical regions, and the first attempt to lay a scientific basis for zoögeography.

3d period. From Wallace to Heilprin, Trouessart and Döderlein. The period of the special researches on single groups of animals, with more or less considerable acceptance of the principles of Wallace; full treatment of single groups.

At the end of the chapter Ortmann refers to a very important paper of Pfeffer: Versuch über die erdgeschichtliche Entwicklung der jetzigen Verbreitungsverhältnisse unserer Thierwelt, Hamburg, 1891, which he considers as possibly the best ever published on zoögeography; he also refers to the new work of J. Walther. Einleitung in die Geologie als historische Wissenschaft I. Theil. Bionomie des Meeres. Beobachtungen über die marinen Lebensbezirke und Existenzbedingungen. Jena. 1893.

The second chapter treats of the most important physical life conditions, the life regions and the facies ('Bionomy'). Ortmann distinguishes the following life regions.

1. The terrestrial region of *Terrestrial* (continental).
2. The fresh-water region or *Fluvial*.
3. The litoral region or *Litoral*.
4. The pelagic region or *Pelagial*.
5. The abyssal region or *Abyssal*.

After this the adaptations of the organisms to the life regions are discussed. The organisms are divided into two groups according to their dependence on the bottom* (Substrat). Animals which are dependent on the bottom and are unable to free themselves from it constitute the Benthos (Haeckel); animals which are not dependent on the bottom, those which during their lifetime never need to come into connection with the coast or the bottom of the ocean constitute the Plankton (Haeckel). Among the benthonic animals three groups are distinguished

according to their more or less intimate connection with the bottom; first, *sessil benthos*, attached to the bottom, receiving food from outside; second, *vagile benthos*, creeping and running on the bottom to obtain food; and third, *nectonic benthos*, able to swim, able to leave the bottom at times, but always forced to return to it. The nectonic condition forms the transition to the *typical plankton*, which is independent of the bottom. The three groups of *benthos* are characteristic for the litoral and abyssal. The true *plankton* is characteristic for the pelagial.

The condition of the facies is of course of the highest importance for the organism. Ortmann distinguishes *primary* and *secondary* facies, the first is formed only by anorganic, the second also by organic material; but of course there are many combinations of the two. Each life region, however, with the exception of the open sea, has its special facies. The basis of the continental facies is the geological structure of the continents. Of great importance are the physiographic differentiations of the land.

In the fluviatile life regions the conditions are similar, but here much depends on the different nature of the medium; that is, the nature of the course of the water—lakes, rivers, etc.

The *litoral*, through its numerous relations to the land, and its frequent dependence on the nature of the latter, shows very numerous differences in its facies.

The facies of the *abyssal* consists of the smallest disintegrated products of minerals and rocks, accompanied by remains of terrestrial and marine organisms.

The *pelagial* has no facies. Peculiarities are produced, however, in the sargassum-masses.

The third chapter is headed: *Distribution of Animals. Increase and prevention of distribution. Means of Distribution.* It begins with the definition of the principle of separation and migration, which is of the greatest importance for the understanding of the processes connected with the origin of species and which is inseparable from zoögeography. This important principle was especially studied by Moriz Wagner, but, as Ortmann very properly states, has been misunderstood by many authors, or not accorded its full value. In order to estimate correctly the value of this principle, and in order

* Brooks, William K. Salpa in its Relation to the Evolution of Life. Stud. Biol. Labor. Johns Hopkins Uni., Vol. V., No. 3, May, 1893. (This paper was unknown to the author.)

to show that without this principle of isolation differentiation of species is unimaginable, Ortman gives his view on the origin of variations and their modification in different species. In regard to the origin of variations he follows those authors which explain variation by direct adaptation of the surroundings (I would prefer to say by the direct influence of the surroundings). He is entirely opposed to Weismann's idea, according to which variation originates by Amphimixis, *i. e.*, the union of two elements (germplasmas of different kind). His principal objection is that Weismann, in order to explain the origin of variation, introduces the principle of Amphimixis, but allows this to operate with material already varied, the difference of the germplasmas. Weismann, in order to explain the origin of differences, takes for granted their preëxistence. For this reason alone Amphimixis as the source of variation is inadmissible. On the other hand it is known by experience that amphimixis, if operating with different material, will not produce new, but will unite together existing differences, especially if the different material is already similar and closely related. In this connection he refers especially to a paper by Pfeffer: *Die inneren Fehler der Weismann'schen Keimplasma-theorie*. Verhandl. Naturw. Ver. Hamburg (3) I., 1894, which seems to be very little known.*

The two factors which form the basis for the process of the formation of species are according to Ortman: 1, the adaptability of the organisms themselves to the external conditions, and 2, the possibility of the inheritance of the characters thus acquired. To these a third factor is added, *natural selection*. Natural selection operates in such a way that out of the number of existing forms those are exterminated which are unfavorably placed. It is not a selection of the fit, but a destruction of the unfit. By this destruction of the bad individuals the average of the totality is raised; that is, the average of the

characters of the forms is changed quite gradually in a definite direction, determined by the external conditions existing at that moment. This process is called *transformation of species* (Pfeffer), or *mutation* (Waagen, Neumayr, also Scott, W. B., On Variations and Mutations, Am. Journ. Sc., 48, 1894, pp. 355-374).

It has been entirely overlooked by Weismann and many others that the process of mutation of *one* species or *one* group of forms is by no means identical with the formation of *new, contemporaneous different* species. Natural selection can only operate in such a way as to improve or modify, in the course of time, a series of forms or a species, as soon as the conditions of existence are changed; out of *one* form another can be produced by selection, but never *two*. The divergency of the directions of mutation, the origin of separate forms from *one* ancestral form, natural selection can never explain. This is only conceivable if the conditions of existence are also differentiated; that is, if they appear different in different regions of the earth at the same time, so that the ancestors of one form living in these different locations are subjected to special conditions. A successful effect of the different life conditions, however, can only be imagined, if the organisms are forced to remain *permanently* in these conditions, if they are prevented from migrating from one region of definite conditions of existence into others with other conditions. Therefore we have, as the *fourth* and most important factor in the formation of different species, the *separation in space* or *isolation*. I think everybody who has ever undertaken to study the geographical distribution of certain genera will agree with these views. I have emphasized it frequently,* as is fully admitted by Ortman. The isolation prevents the cross-

* There are some other papers by G. Pfeffer, which are of great importance in these questions: *Die Umwandlung der Arten ein Vorgang functioneller Selbstgestaltung*. Verhandl. Naturwiss. Verein. Hamburg (3) I., 1894, 44 pp., and *Die Entwicklung. Eine naturwissenschaftliche Betrachtung*. Berlin. R. Friedländer und Sohn. 1895, 42 pp.

* Baur G. Das Variiren der Eidechsegattung *Tropidurus* auf den Galapagos Inseln. Biol. Centralbl. X. 1890, pp. 475-483. Leuckart. Festschrift 1892. pp. 259 ff. On the origin of the Galapagos Islands. Am. Nat. 1891., pp. 217-229, pp. 307-319. Ein Besuch der Galapagos Inseln. Biol. Centralbl. XII. 1892. pp. 221-250. The Differentiation of Species on the Galapagos Islands and the origin of the group. Biol. Lect. Mar. Biol. Lab. Woods Holl 1894. Boston, 1895, pp. 67-78.

ing of the forms, and is fully comparable to artificial selection.

Ortmann ends his discussion with the following résumé: From these considerations it becomes evident that four factors contribute to the formation of different species: 1. *Adaptation to external conditions produces variations.* 2. *The inheritance of these adaptations fixes the variations and shapes groups of forms morphologically related.* 3. *Natural selection modifies the groups and produces mutation in a certain direction.* 4. *The isolation of groups produces differentiation in the direction of mutation and therefore formation of new species.* All these 4 factors must coöperate; none can be absent, and none is possible without the others.

Amphimixis operates in a conservative manner on the average characters, thus leveling the variations, which are capable of preservation, and which are not, therefore, injurious.

The principle of separation has an important bearing on zoögeography, since it follows that species must originate in isolated localities; they are bound to centres of origin. We want to know the place of origin of a given species which at present lives in a certain locality. Did it originate or immigrate there. From this it follows, that in the fauna of each single locality we have to distinguish: First species which originated there, *autochtons*, and second species which immigrated from other localities, *Immigrants*. A third group are the *relicts*, which formerly had an extensive distribution, but are now restricted to a few points. The decision of the nature of a certain animal form in a certain region, whether autochton, immigrant or relict, can only be given by systematics, and here the slightest detail must be considered. At this point zoögeography is not only most intimately connected with systematics, but entirely dependent on it.

The following pages discuss the law of the continuity of the areas of distribution, and the increase and prevention of distribution.

According to the principle of migration, the single animal forms can only extend to such regions as are in connection with the original center: This is the law of the continuity of the areas of distribution. It is a well known fact that the range of every species extends over a number of localities, which are separated

from each other by smaller or larger gaps; these gaps, however, must not be so large that they could not be surpassed by the species in question; thus a continuous communication of the inhabitants of the single localities in which the species is found is possible. Only when this is the case can we speak of a *continuity of life conditions*. As soon, however, as this continuity is interrupted in such a way that it prevents the communication of the species, a *barrier* is formed which prevents its further extension. Continuity of life-conditions increases the distribution of animals; their interruption prevents it.

There are especially two factors which are of importance in this connection, for the first time clearly defined by Pfeffer, the *climatological* and the *topographical*; a third one has been added by Ortmann—the *biological*.

The effect of climatic conditions on the distribution of animals.

A uniform distribution of animals in their life districts presupposes uniformity of the climatic conditions, since all animals are highly dependent on temperature. The importance of the conditions of temperature was first pointed out by Dana; he considered the minimal absolute altitude which the animals need as the most important point, and constructed his *Isocrymes*, lines of equal lowest temperature. That the principle is not correct is generally admitted at present, and it has been replaced by another one. It is not so much the absolute altitude of the temperature which influences animal life, but it is the *Amplitude*, the amount of oscillation, since the temperature in the same locality oscillates according to the seasons. Möbius therefore has distinguished *stenothermous* and *eurythermous* animals. Stenothermous animals are unable to stand considerable oscillations; they are bound to a more uniform temperature; eurythermous animals are not affected by considerable changes. The fundamental difference between the marine and continental conditions of temperature is thereupon discussed. On the continents we have high amplitudes, the surface temperatures of the ocean being more uniform. Since the terrestrial animals are adjusted to high amplitudes—being eurythermous—their distribution is not so much influenced by the climatic differ-

ences; it seems, therefore, that *the topographical factors in the distribution of terrestrial animals are of more importance than climatic factors.*

The matter is different in the case of marine animals. The oscillations of temperature are not so extensive as those of the continents, and the amount of these oscillations is very different in different latitudes. Ortmann arrives at the following conclusion from the given data: *In the equatorial regions of the oceans a nearly uniform temperature prevails with only limited oscillations; these oscillations increase with the latitude, reach their maximum in the temperate and decrease again to a smaller amount in the highest latitudes, the polar regions.*

The conditions on the surface of the oceans are of course different from those at some depth, and the coasts have also an influence on the litoral region. The oscillations of temperature in the sea will appear especially in the upper layers which are exposed to the direct influence of the sun, that is principally in the litoral and pelagial. With increasing depth they decrease and are reduced to a minimum in the deep sea. As is well known, the abyssal has a very constant low temperature, and therefore we cannot expect any climatic effect on the distribution of its animals.

Effects of the topographical conditions on the distribution of animals. Combination of the climatic and topographic principle.

The *continental* is composed of a number of completely separated landmasses; which approach each other closely in the northern hemisphere, but which are always separated by the sea. This character is fundamental and conditions a different development of animals in the separate land areas. These topographical conditions are more important than the climatic differences. A similarly extensive topographical segregation is seen in the *fluvial*; it is even still more highly differentiated, consisting of a very great number of topographically isolated portions, which very often may be connected with one another. These two life zones are distinguished from the marine zones, which are characterized by a more or less complete continuity. The least continuity is shown in the litoral, but even this zone is in uninterrupted connection along the coasts of the continents.

In the abyssal and pelagial zones the continuity is complete.

We can, however, distinguish regions topographically separated in the litoral and pelagial, but this is only possible by the combination of the climatic and topographical conditions. In high northern latitudes the continents approach each other very closely; in the southern hemisphere they are removed from each other. In the northern hemisphere, where the continents are close together, the litoral is continuous; in the southern hemisphere the pelagial has its broadest connections around the southern end of the continents; in both these regions totally different conditions of temperature exist from those of the tropical regions. They form therefore two completely isolated regions, separated by the tropical portions of the litoral. These are formed by four large divisions, one on each side of the great land areas, the old and new world. The *pelagial* is only divided into two portions, the Atlantic and Indo-Pacific, separated topographically by the two large landmasses. It is a very important point that this topographical separation of the tropical parts of these two life regions is only made possible by the climatic differentiation of their circumpolar parts.

The *abyssal* is not affected by such climatic differences and cannot be separated topographically.

Effect of the biological (biocenotic) conditions on the distribution of animals. Since migration takes place in all directions the result will be a conflict between the different immigrants. Since in the resulting competition some forms supplant others, we may use the expression that the latter are checked by biological obstacles. Especially in those cases the struggle for existence is seen in its clearest form.

The chapter concludes with some remarks on *the means of distribution of animals.* *Active* and *passive* means are distinguished.

The means of distribution are different in the different groups of animals; therefore, these groups must show differences in their actual distribution. Many animals have different means of distribution in different stages of their life history. Each single group must be treated by itself for the determination of its distribu-

tion. Every attempt to treat uniformly animal groups, differing in this respect, or even the attempt to compare them, is destined to be a failure.

The fourth chapter treats about *the marine zoögeographical regions*. Ortmann constructs these regions according to the most important physical conditions which are of value to the geographical distribution of animals. It is necessary to examine the relations of each group of animals and each species of the general laws of distribution, and it is, therefore, the aim of scientific zoögeography to solve the question how the single animals behave towards the general laws. From this it follows that for the determination of general regions of distribution we have to consider separately each life region, since the fundamental physical conditions are totally different in every one of them.

The physical regions of the litoral life zone. The principal characters of the litoral are: 1, presence of light; 2, presence of the bottom; and 3, the presence of the medium, *i. e.*, the seawater. The litoral follows generally the coasts of the continents, and extends only over that part of the sea which borders the coast. The distance is of course determined by the inclination of the sea bottom. The limit is the depth to which daylight is able to penetrate, that is about 400 m. Besides there are litoral regions around each island or group of islands. The close relation of the litoral to the land produces, of course, a great difference in the facies, and, therefore, we have very different conditions of existence. The most important conditions are the climatic differences. The litoral is divided by Ortmann into the following regions:

1. Arctic Region.
 - a. Arctic circumpolar subregion.
 - b. Atlantic boreal subregion (with two local faunas).
 - c. Pacific boreal subregion (possibly also with local faunas).
2. Indo-Pacific Region (very uniform).
3. West American Region (very uniform).
4. East American Region (probably with local faunas).
5. West African Region.
 - a. Mediterranean subregion.
 - b. Guinea subregion.

6. Antarctic region (numerous local faunas).

The abyssal life regions.

The principal characters of the abyssal consist in the complete absence of sun light, uniform cold temperature, relative state of rest of the medium and the slightly differentiated character of the facies. In its low temperature the abyssal approaches the Arctic litoral. The extension of the abyssal is enormous; it covers the whole bottom of the oceans. Topographically the abyssal of the whole earth is continuously connected. Therefore, it is impossible, so far, to divide the abyssal into different regions.

The physical regions of the pelagic life zone.

The pelagial resembles the litoral in the presence of sun light, but differs from it in the absence of the 'bottom.' In regard to temperature it is also more like the litoral. There is more variety than in the abyssal. The horizontal extension of the pelagial agrees nearly completely with the abyssal, and is therefore topographically uninterrupted.

But here the climatic conditions act in a manner similar to those of the litoral. In the equatorial regions we find the surface of the water of equally high temperature. Towards the poles the temperature becomes lower, and the amplitude of the oscillations increases; still farther towards the poles, the temperature of the water becomes again more uniform but cold.

The Pelagial is divided by Ortmann into four regions:

1. Arctic Region.
 - a. Arctic-circumpolar subregion.
 - b. Atlantic-boreal subregion.
 - c. Pacific-boreal subregion.
2. Indo-Pacific Region.
3. Atlantic Region.
4. Antarctic Region.
 - a. Notal*-circumpolar subregion.

* Ortmann was unable to trace the name *notalian*, whose original appliance by Gill was introduced in 1884 in a very interesting paper. The Principles of Zoögeography, a presidential address delivered at the third anniversary meeting of the Biological Society of Washington, January 19, 1883. Proc. Biol. Soc. Washington, Vol. II., 1882-1884, pp. 39. Washington, 1884.

b. Antarctic-circumpolar subregion.

The Pelagial of the Indo-Pacific Region is completely isolated from that of the Atlantic Region by the notal-circumpolar subregion.

The fifth chapter is a very important one; it discusses the influence of the earth's geological changes on the distribution of animals, and the geological change of the climatic, topographical and biological conditions. The present condition of the animal kingdom is the final result of a series of geological changes, and the present distribution is caused by the conditions of former times. We know through paleontology that in former periods animals existed in regions in which they are missing to-day; the geographical distribution has, therefore, changed in the course of the earth history. There is no longer any doubt that a change in the distribution of water and land, in the climate and in the biological conditions, has taken place; the question is: how extensive was this change?

Climatic changes: The view of Neumayer that even during the Jurassic period three climatic zones existed, an arctic, temperate and equatorial, Ortmann rejects with Heilprin and Pfeffer. His view is the following: As far as our present knowledge reaches, we may assume, with certainty, that only during the course of the Tertiary did climatic differences develop. The principal point of this differentiation consists in the separation of a zone around the poles, in which the seasons of the year underwent a change in the height of temperature. This change increased until there was a sharp contrast between the new and the original uniform conditions of temperature which remained towards the equator. Before this climatic separation appeared, certainly in pre-Tertiary time, a uniform tropical climate existed on the earth, and no climatic regions could be developed in relation to the distribution of animals.

Topographic changes:

Ortmann is opposed to the theory, especially advocated by Wallace, of the consistency of continents and oceans since the oldest times. It has often been attempted, he says, to reconstruct the continents existing in former geological periods. The means of doing this consist first in the tectonic method of geology, and

second in the data from the distribution of animals and plants. I shall not go into detail concerning these questions, which have been discussed lately very frequently (Blanford, Yukes-Brown, Ihering, Baur). I fully agree with Ortmann that the distribution of land and water has very considerably and frequently changed during geological times, and that these changes must have had an enormous effect on the distribution and differentiation of the fauna. The same holds good of the fluvial, the life zones of the fresh water.

But it is quite different with the marine life-zones. The litoral follows essentially the lines of the continents. All changes affecting the continent affected also the litoral. We are bound to accept for the litoral a topographical continuity existing from the earliest times. Therefore it is best to assume that in Pre-Tertiary time, before climatic differences existed, the litoral was in complete climatic and topographical continuity; and that there was no possibility of separation into regions according to climatic and topographic differences. With the appearance of the climatic differentiation in the Tertiary the conditions of the litoral changed, and they gradually reached the form in which they appear to-day. At first, however, there existed a considerable difference from the present conditions, at any rate through one part of the Tertiary times, which had its cause in the nature of the circumtropical girdle. There was still a connection between the Atlantic and Pacific, South and North America being still separated. But at the poles the Atlantic and Pacific were already climatically differentiated. There existed also probably a connection between the Mediterranean and Indian Ocean. If this was really so, there were present perhaps from the beginning to the middle of the Tertiary two large groups of tropical litoral; an *American* and a *Mediterranean-Indo-Pacific* region. Possibly the West African region belonged to the American litoral.

From this condition the present distribution of the litoral and its regions developed. The Mediterranean was separated from the Indian Ocean and acquired connection with the Atlantic; the Isthmus of Panama separated the East American from the West American litoral.

Especially the latter process was a relatively recent one, but it existed long enough to produce differences in the two faunas. The former conditions on the other hand can be recognized very frequently in the present distribution.

Probably the *abyssal* life-zone was formerly not so extensive as to-day. It is probable also that during periods before a decrease of temperature at the poles the conditions of temperature were quite different from our present ones. The *abyssal* may therefore be of relatively recent date.

The *pelagial* must be very old, certainly as old as the litoral and continental. It was quite continuous in former times. With the climatic differentiation of the poles a corresponding differentiation of the pelagial took place; the circumtropical belt remained for some time continuous. The separation into the Atlantic and Pacific region was produced by the Isthmus of Panama. This differentiation is very recent, and the pelagial of the two new regions are exceedingly similar.

The chapter concludes with some remarks on the biological (biocœnotic) changes of the earth history.

The sixth chapter is devoted to the *Bionomy and geographical distribution of the Decapoda*. Dr. Ortmann is an authority on this group of crustaceans. An exhaustive essay on the geographical distribution, he says, is at present not possible, since some of the smaller groups have not been sufficiently studied; but he thinks it feasible to give a general view of the bearing of the *Decapoda* on the points discussed in the former chapters.

In many ways, he says, the *Decapoda* are a typical group for zoögeographical studies. Here all the possibilities of bionomic conditions are found, and they therefore constitute an especially good example of distribution. The ancestors of the *Decapoda* were nectonic animals, which were dependent on the bottom, could therefore only cross in the litoral or abyssal; we may exclude the abyssal, and have to consider the first *Decapoda* as nectonic litoral forms.

By far the greatest number of the *Decapoda* is *litoral*; a great number, however, lives also in the *abyssal*, and partially quite distinct systematic groups have their main distribution in this

region. The most important families which are exclusively abyssal are: the Acanthephyridæ and Nematocarcinidæ, the Glyphocrangonidæ, Ergonidæ and Thaumastochelidæ. All these as compared with their nearest relatives are more primitive groups, which must have immigrated into the abyssal, already in remote ages undergoing thereby but slight modification. On the other hand, the abyssal received more forms in later times. These are groups, the nearest relatives of which, often belonging to the same genus, are still found in the litoral. It is interesting to note that some of the latter, for instance the Crangonidæ and Lithodidæ, perhaps also the Pandalidæ, point quite definitely to the polar litoral. The opinion that the abyssal is especially characterized by primitive forms is not correct; both the litoral and fluvial possess primitive forms.

The only Decapods which have been adapted to the *Pelagial* as true planctonic Crustaceans, are the *Sergestidæ*, which represent a highly developed branch of the nectonic-litoral Penaidæ; they seem therefore to be of comparatively great age. The other forms of the high sea, the inhabitants of the Sargassum are quite isolated and belong to members of quite different groups. Forms like *Varuna* and the *Plagusinæ* can hardly be considered pelagic; since they often live on the coasts, and are perhaps driven out on swimming objects more frequently to the open sea, as a result of their mode of life.

The most important *fluvatile* Decapods are the *Atyidæ*, the group *Palæmon* and *Bithynis* among the *Palæmonidæ*, the *Potamobiidæ* and *Parastacidæ*; the *Aegleidæ* (represented by a single form), the *Thelphusidæ* and *Sesarminæ*. The two last are partially adapted to subterranean life. These groups are of very different age, and their immigration into the fresh water has taken place at very different times; hence the geographical distribution of each of these groups must be studied separately.

True continental forms, perhaps sometimes still frequenting the sea, are the *Cœnobitidæ* and *Gecarcinidæ*; both are morphologically recent and specialized groups.

The Decapods of the litoral and abyssal inhabit all the different facies of these zones.

On the succeeding pages the characteristic

forms of the Decapods are given for the different regions.

The last chapter gives a short review of our present knowledge of the geographical distribution of the other groups of animals.

A map shows the distribution of the regions and subregions of the marine life zones, the littoral, abyssal and pelagial. G. BAUR.

Introduction to the Study of Fungi. By M. C. COOKE, LL. D., author of 'Hand-book of British Fungi,' *Fungi, Their Nature, Uses, etc.* 8vo., pp. 360. London, Adam and Charles Black. 1895.

This, the latest and, as stated in the preface, 'probably last contribution to British Mycology' from Dr. Cooke, is a work 'for the use of collectors.' It is divided into three parts; namely, organography, with eight chapters; classification, with fifteen chapters—by far the largest portion of the book—and two chapters upon distribution.

Under organography there is a chapter each upon: The mycelium, carpophore, receptacle, fructification, fertilization, dichocarpism saprophytes and parasites and constituents. The author, as a lifelong student of his subject, recognizes many of the difficulties that lie in the pathway of the collector and endeavors to help him to overcome them. His method is to begin with the more common and easily seen forms and pass to the less conspicuous. Thus with mycelium the start is made with the spawn, or artificial 'bricks' of the cultivated mushroom, and he afterward considers the filaments of mildews and then the more complex forms as illustrated by the ergot grains and other indurated forms. The work is fairly well illustrated, there being in the neighborhood of one hundred small wood cuts taken in large part from the author's 'Hand-book.' From one who has written so largely upon the topics considered in the book before us there is perhaps no occasion for new engravings, but there is, nevertheless, a lack of freshness that the mycologist notes upon first taking up this work.

The carpophore, defined in brief as 'the fruit-bearer,' logically and in reality follows from the mycelium, and in the chapter upon it, it is shown in various stages of complexity from the com-

paratively simple bearing of spores upon the free tips of threads to the globose compact structure, where the spores are produced in sacs within the closely knit tissue. The author does not hesitate to use the names of genera without stint in citing instances, and these names, being set in italics, give the pages a heavy cast of countenance that might not please the beginner upon the first acquaintance. In fact it is to be inferred that Dr. Cooke expects more of his latest work than a mere introduction. Some of his earlier books may well serve as a preparation for this. A case, and not an extreme one, is the following upon page 262: "In *Chaetophoma* the penthecia resemble those of *Phoma*; but are innate in a dermatoid subiculum resembling *Fumago* or *Asterina*." Here we have the free use of genera, but it is innate, dermatoid and subiculum that the beginner might stumble over. He will naturally turn to the glossary to find none of these words mentioned and be disappointed. Upon the other hand, he may notice in the brief glossary the following: 'Cryptogamia—applied to the lower orders of plants in which there are no conspicuous flowers as there are in Phanerogamia.' To say the least, the mind of the reviewer is left in the dark concerning inconspicuous flowers.

The chapter upon fructification precedes that on fertilization, which does not seem entirely logical; but it is to be remembered that the author holds that sexual reproduction is not well established, or, in his own words, "the instances in which sexual reproduction has been determined are exceptionally few." This subject of fertilization is treated somewhat at length with several engravings, and it is a surprise to have it finally dismissed with the remark that "experience and investigation of forty years have shown that lichens and fungi still remain practical exceptions to the rule of sexuality."

The above view naturally leads one to look at the bibliography under each subject, and it is found far from complete. For the rusts (*Uredineæ*) the only American authority cited is Dr. Farlow. Under the circumstances it is a pleasure to find that Ellis and Everhart receive mention under the bibliography of the Pyrenomyces, Morgan under puff-ball fungi, and

there the matter ends, save under the head of bibliography for geographical distribution, where the list of nine, not all American, begins with Schweinitz and includes Berkeley, Curtis, Ellis and Peck. It is noted that Dr. Burrell is credited with first discovering a plant disease of bacterial origin; namely, 'the shrivelling o pears' in 1880 due to *Micrococcus amylovorus*.

The total number of described species of fungi is given as 40,000, an estimate founded upon the Sylloge of Dr. Saccardo.

Under the chapter upon geographical distribution it is stated that the fungi are not yet well enough known to more than conjecture as to their distribution on the earth. China is still an unknown land and India but little better, and Africa is a 'dark continent' so far as fungi are concerned. The fleshy fungi are mostly in the temperate regions. Nearly the whole of the Amaniteæ groups of exceedingly poisonous toadstools are rarely met with in the tropics.

Under classification some of the salient points are introduced, as naked and covered spores, perfect and imperfect forms and the character of the spore covering. While not accepting the classification offered by Brefeld in full, Dr. Cooke recognizes its influence and summarizes it in tabulated form. In the same chapter a page and a half is given to the drawing of lines of contrast between lichens and fungi, and the first page of the introductory chapter states, "It is now known that aquatic fungi are not an impossibility, that algæ may grow in damp atmosphere and that some portions of the substance of lichens may be derived from their matrix." From these statements the student would gain no encouragement to incline toward the modern theory of the fungo-algal conception of lichens.

The book is printed upon unusually heavy paper with uncut edges and weighs about three pounds. Half the size and bulk would make it many times more companionable.

While the faults have been most largely pointed out, the book cannot but be useful and aid the collector to reach the conclusion expressed in the last sentence of the work: "The whole history of one species worked out with perseverance and intelligence will present the

key to a knowledge of many kindred species and always prove to be a valuable contribution to science when the names of species are changed or forgotten." When this fact is realized in the collector he becomes a working factor in the strict sense for the advancement of his science. BYRON D. HALSTED.

A Preliminary Report on the Geology of South Dakota. By J. E. TODD. South Dakota Geological Survey. Bulletin No. I. Sioux Falls, South Dakota. 1895. Pp. viii, 172. Plates V., figures 2, and preliminary geologic map of South Dakota.

In the above report Prof. Todd, who is the State Geologist, has summarized what is known of the geology of South Dakota. The author's studies of the geology of this State began in 1881, since which time his connection with the United States and State Surveys has enabled him to examine in the field most of the geological formations found in South Dakota. The work is written in popular form in order that it may serve as a geological guide to the citizens of the State; but in its pages is also found matter of value to the teacher and geologist.

The report contains a chapter devoted to each of the following topics: Introduction, topographic features, sketch of the geology of the State, eruptive rocks, geological history of South Dakota, and economic geology, while the description of the geological formations of the State occupies four chapters, making ten in all. Prof. Todd finds that the following systems are represented: Huronian, Cambrian, Lower Silurian, Carboniferous, Triassic, Jurassic, Cretaceous, Tertiary and Quaternary, while 25 feet of shales in the vicinity of Deadwood is referred doubtfully to the Devonian. On consulting the geologic map it will be seen that about two-thirds of the State is covered by formations belonging to the Cretaceous system, of which the Colorado group is first in area and the Laramie second. After the Cretaceous system the Miocene of the Tertiary is second in areal extent, and the Huronian third.

Among minerals of economic value, gold is the most important, the Black Hills in 1893 producing \$4,000,000. The author says that the oxide of tin (cassiterite) 'occurs very generally.

in the granite rocks about Harney Peak,' but there is no statement in reference to the production of the mines in this region, the development of which has been a subject of general interest. The best building stones of the State are the red Sioux quartzite of the Archæan, while in the Black Hills is the gray or reddish Dakota sandstone of the Cretaceous, which is said to compare very favorably with the well known Berea stone of northern Ohio.

The State Geologist expresses the hope that this Bulletin 'may be but the first of a long series' that will be published by the State, and the geologists of the country heartily echo this wish. It remains for the prosperous agricultural States of the 'Great Plains' to remove the stigma resting upon them in having neglected for so many years the study of their natural history and geology. It is not true, as has been popularly supposed, that they are comparatively barren in mineral resources, and, furthermore, there are problems of the greatest scientific interest awaiting investigation. The failure by the Dakotas, Nebraska and Kansas to provide for adequate geological surveys is in marked contrast to the liberal support which such surveys have received from the tier of States to the east—Minnesota, Iowa, Missouri and Arkansas—surveys which have accurately described the geology of those States and made known their natural resources, the development of which has added greatly to their wealth.

C. S. PROSSER.

Die Chemie der Zuckerarten. By DR. EDMUND O. VON LIPPMANN. Braunschweig, Vieweg und Sohn. 1895. Pp. xxvi+1176.

In 1879 von Lippmann published in the *Zeitschrift des Vereins für die Rübenzucker-Industrie des Deutschen Reichs*, a memoir entitled 'Monographie der Zuckerarten.' This valuable compilation was practically a summary of all that was known at that time about the more important carbo-hydrates; it filled about seventy quarto-pages of the journal in which it appeared.

Three years later the author followed the treatise named with a book, 'Die Zuckerarten und ihre Derivate.' This was based on his former publication and aimed to present all known

facts regarding the physical and chemical properties of the different sugars.

The unexpected and certainly unprecedented growth which sugar chemistry experienced within the decade following the issue of this work, made a new, up-to-date, issue of the same greatly needed and desired. Numerous requests to undertake this task were addressed to its author and these wishes were finally responded to by the publication of the work forming the subject of this notice.

Die Chemie der Zuckerarten has its subject-matter divided into four parts, which, in turn, are subdivided into sections.

The first three parts are given to, respectively, the mono-, the di- and the tri-saccharides. The fourth part contains discussions on: the constitution, configuration and synthesis of the sugars; the relations of optical and calorimetric constants; the origin of the sugars in plants; the physiological importance of the sugars.

The saccharides are arranged and discussed in sequence according to the number of carbon atoms they contain. Thus, of the mono-saccharides, the bioses, sugars having two atoms of carbon, are first considered; next come the trioses, the tetroses, the pentoses, etc.

The hexoses (the $C_6H_{12}O_6$ group) are divided into the aldo- and the keto-hexoses; the former exhibiting the aldehyde-structure, the latter containing the characteristic ketone-group. Dextrose (d-glykose) is a representative of the former, levulose (d-fruktose) of the last-named class.

No less than 234 pages are given to dextrose. This may indicate the thoroughness which characterizes the whole work.

The most important of the di-saccharides, is of course, sucrose (cane sugar). The author devotes 244 pages to its consideration. Lactose, maltose and iso-maltose are also given exhaustive treatment in this part of the book.

The leading representative of the tri-saccharides is raffinose. This substance, melecitose and a few other carbo-hydrates of analogous constitution receive the attention due them, and are followed by the learned and able disquisitions on the constitution, configuration and synthesis of the sugars, etc., previously mentioned.

Very full and complete indices of subjects and authors conclude the volume.

The time and labor expended merely in the collection of the material contained in this publication must have been enormous. Some faint conception of this may perhaps be gained on learning that no less than two thousand two hundred and twenty-two authors are referred to or quoted in its pages, exact reference to their writings being given in all cases.

The style throughout is scholarly and lucid. The treatment of the subject-matter is fair and impartial. No pains have been spared to make this work a standard one; beyond question, von Lippmann's *Chemie der Zuckerarten* is a classic of chemical literature.

FERDINAND G. WIECHMANN.

SCIENTIFIC JOURNALS.

AMERICAN JOURNAL OF SCIENCE.

THE March number contains three articles upon the subject of the Röntgen rays, which has excited so much interest during the past month. The first of these is by A. W. Wright. After a brief history of the subject, the author describes in some detail the experiments which have been performed at the Sloane physical laboratory in New Haven. These have yielded results similar to those described elsewhere, but with a remarkable degree of refinement. Examples are given of a picture made from an aluminum medal, in which the relief on both sides is shown, also the lettering and milling around the edge. It is stated that in the original negative it is almost possible to decipher the individual letters. The details are given of the special methods which have been found most successful in yielding good results. Some of the typical pictures obtained are given on an accompanying plate. A second plate shows the impressions given upon a sensitive surface by diverging stream lines through two parallel slits in a copper plate. Three experiments were performed: first, with both slits open simultaneously; second, with only one open at a time, so that the streams were independent; and third, with the two streams passing by a powerful magnet. The first two showed very little, if any, distinct action between the

streams themselves as regards their direction. The effect of the magnet in the third case was also negative. In another experiment, however, in which a very thin gold leaf was interposed in the path of the rays, a deflection by the magnet of about half a degree was observed, due to the loading of the streams with metallic particles; the mutual repulsion of the streams was also clearly shown. In all these cases the rays were proved by measurement to leave the surface of the glass of the vacuum tube nearly normally. The article closes with a quotation from an earlier paper (1870) by the same author, upon electrical shadows from the Holtz machine, to a certain extent anticipating the results that have recently excited so much interest.

The paper by Trowbridge shows how pieces of metal can be located, for example, in the human body by cathode photography, based upon a principle analogous to that employed in the Rumford photometer. He used two Crookes' tubes with two terminals at an angle with each other, and excited by a Tesla coil. The author states that by use of the Tesla coil he has succeeded in obtaining pictures in less than a minute. The destruction of the tubes is prevented by placing them in a vessel filled with paraffine oil, while the oil is cooled by snow or ice placed outside.

The third article, by H. A. Rowland, W. R. Carmichael and L. J. Briggs, discusses briefly the sources of the rays. By using a tube of a very high degree of exhaustion it was demonstrated conclusively that the main source of the rays was a minute point on the *anode* nearest to the cathode. At times a minute point of light appeared at this point but not always. Added to this source the whole of the *anode* gave out a few rays. From the cathode no rays whatever came; neither were there any from the glass of the tube where the cathode rays struck it as described by Röntgen. "In the other tubes there seemed to be diffuse sources, probably due in part to the oscillatory discharge, but in no case did the cathode rays seem to have anything to do with the Röntgen rays."

The first article of the number is by J. B. Hatcher upon 'Recent and Fossil Tapirs.' In this he gives a detailed description of the

new species *Protapirus validus*, and also of a number of allied forms. Further he gives a condensed summary of the classification and relations of recent tapirs, with an account of their phylogeny. The article is accompanied by four plates. Another geological article is by Robert Bell, summarizing the proofs of the rise in the land about Hudson Bay. These proofs are of varied character, and the cumulative evidence is so strong that there can hardly be any question as to the conclusion reached. The rise in land has been comparatively rapid, and the elevation is believed to be still going on. O. C. Marsh, in a short article upon the 'Wealden Formation of England,' shows that it is unquestionably to be referred to the Jurassic instead of the Cretaceous, as formerly believed. S. F. Peckham and Laura A. Linton have an article on 'Trinidad Pitch,' in which analyses are given of some twenty-seven specimens obtained at different points in the neighborhood of Pitch Lake, Trinidad. The article presents some important conclusions as to the composition of this material in general. G. R. Putnam describes the results of recent pendulum observations at different stations in the Southern United States, more particularly at New Orleans, Galveston, Austin and Laredo. These show a very slight excess of gravity near the Gulf coast as compared with interior stations; this excess, however, is so small as to indicate a close approach to the condition of hydrostatic equilibrium called for by the principle of isostasy. Otherwise the large accumulation of the sediment in the Gulf, brought down by the Mississippi from its drainage area, would lead one to expect a greater increase in gravity at the points named.

A brief account of a new meteorite from Forsyth county, North Carolina, is given by Dr. E. A. de Schweinitz. F. A. Gooch and A. W. Peirce describe 'a method for the separation of selenium from tellurium, based upon the difference of the bromides.' F. P. Adams and B. J. Harrington describe some interesting minerals from the nepheline-syenite of Dunganon county, Ontario. One of these is a new variety of hornblende, having a constitution analogous to that of garnet, and peculiar optical properties. The name *Hastingsite* is sug-

gested for it. The other is a titaniferous andradite. S. L. Penfield and J. H. Pratt describe the occurrence of the rare mineral *thammasite*. This species has been known hitherto only from Sweden and is one of the most remarkable of minerals in composition, being a hydrous silicate-carbonate-sulphate of calcium. It contains 43 % of water and has a specific gravity of only 1.88. The analysis here given confirms those made of the Swedish mineral; the authors suggest a structural formula to explain the anomalous composition, including the fact that the water goes off at four different temperatures.

AMERICAN CHEMICAL JOURNAL, FEBRUARY.

On Halogen Addition Products of the Anilides: By H. L. WHEELER and P. T. WALDEN. The authors find that when certain salts of the anilides are treated with bromine containing hydrobromic acid, perhalides are formed which are analogous to the caesium and ammonium perhalides.

The Action of the Halogens on the Methylamines: By IRA REMSEN and JAMES F. NORRIS. The formation of a product containing two bromine atoms, by the action of bromine on trimethylamine hydrobromide, led to the study of the action of the halogens on trimethylamine. In the product formed the bromine appears to replace the hydrogen of the hydrobromide. A similar compound containing iodine is formed, and probably one containing both bromine and iodine.

On Silicides: By G. DE CHALMOT. By the use of the electric furnace the author has obtained crystals of copper and silver silicides, which, however, always contain some calcium as an impurity.

Some of the Properties of Liquid Hydriodic Acid: By R. S. NORRIS and F. G. COTTRELL. The authors have prepared pure hydriodic acid by condensing the dry gas in tubes cooled by solid carbon dioxide, and have studied the action of this acid on many metals, oxides, gases and non-metallic elements. This acid does not act on carbonates and in general is less active than the solution of the gas in water.

On the Preparation of Hydrobromic and Hy-

diiodic Acids: By J. H. KASTLE and J. H. BULLOCK. The use of naphthalene and bromine is recommended for making hydrobromic acid, and a mixture of resin, iodine and sand for hydriodic acid.

Turmerol: By C. LORING JACKSON and W. H. WARREN. Turmerol, prepared from the crude product by distilling *in vacuo*, when treated with nitric acids yields paratoluic acid. It is considered to be an alcohol containing a benzene ring with methyl and carbon side chains in the para position.

Bromine derivatives of Resorcline: By C. LORING JACKSON and F. L. DUNLAP. It is not possible to replace two of the bromine atoms in $C_6HBr_3(OC_2H_5)_2$ by hydrogen, unless the hydrogen atom is first replaced by the nitro group. The introduction of a hydroxyl group also facilitates the replacement of the bromine. The ethoxy groups do not weaken the affinity of the bromine as the free tribromoresorcline is easily decomposed.

Trinitrophenylmalonic ester: By C. LORING JACKSON and C. A. SOCH. The method of preparation, reactions and derivatives of picrylmalonic ester, which Dittrich was unable to obtain, are given in this paper.

The artificial production of Asphalt from Petroleum: By C. F. MABERY and J. H. DYERLEY. After removing the oils used for illuminating purposes, the residue is distilled slowly while air is drawn through. Products of different specific gravity are separated and used for various purposes in which asphalt has been used.

On the Action of Phosphorus Pentachloride on Parasulphaminebenzoic Acid: By IRA REMSEN, R. N. HARTMAN and A. M. MUCHENFUSS. The product formed by the action of phosphorus pentachloride on parasulphaminebenzoic acid, when heated, decomposes in two stages, and the final product contains the nitrogen group in combination with the carbon atom instead of with the sulphone group as at first. Some light is thrown on the nature of this change by these investigations.

This number also contains a review of the work on *Chemical Technology* by GROVES and THORP. Vol. II.

J. ELLIOTT GILPIN.

PSYCHE, MARCH.

THE number is mostly occupied by the Presidential address of Clarence M. Weed on the 'Hibernation of Aphides,' summarizing previous knowledge. J. W. Folsom gives an account of the oviposition of *Thanaos juvenalis*, and a supplement is occupied by descriptions of insects, mostly New Mexican, by T. D. A. Cockerell and C. F. Baker.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES.

AT the meeting of the Geological Section of the New York Academy of Sciences, held on February 17, 1896, the following papers were presented:

The first paper was read by Mr. L. McI. Luqueer, entitled 'Notes on Recent Accessions of Interesting Minerals,' with exhibition of specimens. Mr. Luqueer described in detail the minerals that he had recently discovered at the feldspar quarries in the northeastern part of Westchester county. They include uraninite, autunite, uranophane, washingtonite and the common minerals of pegmatite veins. He showed that the veins occurred in close association with an area of augen-gneiss, regarded as intrusive and now being studied by himself and Mr. Heinrich Ries.

The second paper was by J. F. Kemp, entitled 'The Cripple Creek Gold Mining District of Colorado.' The paper was illustrated by about thirty lantern views, most of which were taken by the speaker during the past summer, and by an extensive series of rocks and ores. After a brief historical review the region was described in detail, without, however, introducing anything essential that is not already contained in the Cripple Creek atlas folio of the United States Geological Survey, which was prepared by Messrs. Cross and Penrose.

J. F. KEMP,
Secretary.

THE TORREY BOTANICAL CLUB.

THE regular meeting of the Torrey Botanical Club was held on Tuesday evening, February 11th. Two new members were elected. Mr. A. A. Heller contributed an interesting paper

entitled 'Botanizing in Hawaii.' Lantern views were presented illustrating the geography and topography of the islands and a number of the more interesting plants. About twenty-five per cent. of the species collected are supposed to be undescribed. The endemic character of the flora of the islands, and of each island as contrasted with the others, was dwelt upon.

Dr. Arthur Hollick, through Dr. Britton, submitted a paper on 'New Leguminous Pods from the Yellow Gravel Sandstone at Bridgeton, N. J.' The paper was illustrated by specimens belonging to the genera *Lonchocarpus* and *Mezoneurum*.

H. H. RUSBY,
Recording Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held February 5th; forty-four persons present. Mr. Herbert Lyon Jones spoke of the biological adaptations of desert plants to their surroundings, mentioning first the food of plants, their adaptations for retaining moisture, and the adaptations that go to preserve the moisture. The struggle of plants in tropical regions was noted; also the struggle of desert plants against inorganic nature. The effects of the amount of rain, the variations in leaf surface, and the protections afforded to leaf and to stem were discussed. Where the rainfall is limited to a few inches the leaves are thickened and covered with a coating of wax; in some regions of considerable rainfall the plants suddenly put out delicate leaves. The Australian Acacias show the most numerous adaptations of leaf surface; in some Cacti the leaf surface is entirely wanting, the function being performed by the stems.

The protection afforded to leaf and stem by coatings of wax is always thick in desert plants, and the hairy coatings form a striking adaptation in many plants, and are best shown in the plants of the Mediterranean flora.

The fertilization of desert plants was described in detail, also the distribution of their seeds and fruits; and Mr. Jones closed with remarks explanatory of the fine series of lantern slides illustrating the biological adaptations of desert plants to their surroundings.

SAMUEL HENSHAW,
Secretary.

ACADEMY OF NATURAL SCIENCES, PHILADELPHIA, FEBRUARY 18.

A PAPER entitled as follows was presented for publication: 'Contributions to the Life History of Plants, No. XII,' by Thomas Meehan: 1. Fecundity of *Heliophytum Indicum*; 2. Origin of the Forms of Flowers; 3. Spines in the Citrus Family; 4. Flowers and Flowering of *Lamium purpureum*; 5. Cleistogamy in *Umbelliferae*; 6. Rhythmic Growth in Plants; 7. Pellucid dots in some species of *Hypericum*; 8. Honey Glands of Flowers; 9. Varying Phyllotaxis in the Elm; 10. Special Features in a Study of *Cornus stolonifera*; 11. Folial Origin of Cauline Structures; 12. Polarity in the leaves of the Compass and other plants; 13. Hybrids in Nature; 14. Origin and Nature of Plant Glands; 15. Nutrition as affecting the Forms of Plants and their Floral Organs; 16. Some Neglected Studies.

Mr. D. S. Holman exhibited a new stage for the microscope devised for the purpose of studying large objects and widely spread preparations. It can be adapted to all instruments provided with square stages and has a motion of two inches each way.

Preparations of minerals containing diatoms in transverse section and other microscopic arrangements of diatoms prepared by Mr. John A. Schulze were exhibited by Mr. F. J. Keeley.

Prof. Edw. D. Cope described specimens of fossil reptilia from the Permian and Trias. They belonged to the order Cotylosauria which had been described by him in 1879, and was afterwards characterized by Seeley from African types. The order embraces the families Elginiidæ, Pariasauridæ, Diadectidæ and Pariotichidæ, the distribution and characters of which were dwelt on. New genera of Diadectidæ were described under the names *Bolbodon* and *Diatomodon*, the teeth of which, as well as of the other genera of the family, were illustrated. The *Platodontia* may have been derived from the *Diadectidæ*. The roof over the temporal fossa and the foramen for the temporal eye were illustrated by specimens. The molar teeth of a species of *Empedias*, the cranium of *Bolbodon tenuitectis* and the lower jaw of *Diatomodon* were exhibited. Another form described under

the name *Conodectes favosus* may belong to the *Diadectidæ*, but its relationships are at present uncertain.

EDW. J. NOLAN,
Recording Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the forty-third meeting of this Society, held at Washington, D. C., February 12, 1896, President S. F. Emmons in the chair, communications were presented as follows:

Structure of the Elk Garden Coal-Fields: By MR. J. A. TAFF. The Elk Garden coal-field comprises about one-third of the area of the Piedmont sheet (of Geol. Atlas of United States, U. S. G. S.), and extends about S. 30 W. across its center. This coal-field is limited on the east by the Allegheny front and on the west by the Backbone Mountain. The south branch of the Potomac drains the field from the Grant county line northward, while the southern part is in the basins of Red Creek and Blackwater River.

In topography as well as in structure the Allegheny front marks the dividing line between the middle or Great Valley and the western or plateau divisions of the Appalachian province. The valley country presents almost level crested mountain ridges, with smooth valleys between and the Allegheny front faces it with an escarpment 1100 to 2000 feet high. The Elk Garden coal-field here represents a part of the plateau region. It is not a smooth plain, but in its nearly flat surface points may be seen in the ridges which extend from the Allegheny front and Backbone Mountain into the Potomac Gorge. The structure of the valley region is illustrated by the topographic types, *i. e.*, sharp anticlinal folds in the mountain ridges and obtuse, wide and undulating folds in the valleys.

In the Elk Garden coal-field the topography is more diversified. Both the anticlinal and synclinal folds are occupied by valleys and the mountains are upon their borders. From the crests of Allegheny front and Backbone Mountain the dips of the conglomerate are 18° to 25° , but soon decrease and approach the Potomac valley almost horizontally, forming thus an obtuse synclinal basin. This basin rises toward the southwest and divides near the center of

the field, one division following Stony River and Red Creek valleys, while the other extends with the Potomac and passes southwest beyond Fairfax Knob. This division of the main synclinal basin is due to a high anticlinal fold which pitches downward between Canaan and and Brown Mountains and is lost in undulations near the center of the field.

The structure of the Elk Garden coal-field presents the rocks most advantageously for the coal operator. The North Potomac river has severed the five productive coal seams ranging in thickness from four to fourteen feet, so that they incline downwards toward its gorge and also allow easy access for rail transportation.

The paper was illustrated by topographic and relief maps and by structure sections.

Disintegration and Decomposition of Diabase at Medford, Mass. By GEO. P. MERRILL.

Mr. Merrill described in considerable detail the chemical and physical changes which had taken place in the breaking down of the diabase at Medford, giving analyses of the fresh and decomposed rock as well as of the portions removed by solvents. The most interesting results brought out were: That the firm rock yielded up nearly 36% of its constituents to the solvent action of hydrochloric acid and sodium carbonate solutions, as against 32.3% by the residual sand; further, that in the process of degeneration some 20% of material was lost, the various constituents being removed in the following order, that which suffered most heavily being mentioned first: K_2O ; CaO ; MgO ; Fe_2O_3 ; SiO_2 ; Na_2O ; P_2O_5 ; the alumina, which served as the basis for calculation, being for the time assumed to have remained constant.

The degeneration was regarded as being mainly postglacial, and as due wholly to atmospheric agencies. Remarks were made as to the relative rapidity of degeneration in high and low latitudes, Mr. Merrill taking the ground that the apparent greater rapidity of decay in warm latitudes and in forested areas, was due to protection from erosion whereby the disintegrated material was allowed to accumulate. He, however, believed that there was a difference in kind in the degeneration in high

and low latitudes, in the former mechanical agencies prevailing, and in the latter chemical.

Notes on the Geology of the San Carlos Coal Field, Trans-Pecos, Texas. By T. WAYLAND VAUGHAN.

The author gave the results of a reconnaissance made jointly with Mr. T. W. Stanton, of the U. S. Geological Survey, during the field season of 1895. The coal field is situated in the Veija Mountains. Some general observations on the structure and topographic features of the region were made. Two detailed sections of the mountains were described. The general features of the combined sections, beginning at the top, are:

3. A massive lava-flow of quartz-pantellerite, which forms the summit of the mountains and from 400-600 feet thick.

2. A series of interbedded massive and fragmental rhyolites and conglomerates, sandstones and clays, into which a sheet of basalt has been intruded. South of Chispa this series is about fifteen hundred feet thick, but it is not so thick at San Carlos, where there is not such a variety of volcanic products.

1. Alternating beds of sands and clays—at San Carlos about fifteen hundred feet thick—and in which the coal occurs. Vertebrate fossils of Cretaceous age were found in the sandstones and clays above the coal. Below the coal a rich invertebrate fauna was collected, whose age was determined by Mr. Stanton to be Pierre (in the terminology of the Western Interior Region) or Taylor (in the terminology of the Texas Region). The age of the coal was determined to be Pierre or Taylor, as Mr. E. T. Dumble had previously shown. About seven miles southwest of Chispa a fault was described by which the Benton shales had been carried down below limestone belonging to the Fredericksburg division (of the Lower Cretaceous). The Benton shales are thinly laminated, bluish, calcareous shales, and contain *Inoceramus labiatus*, a fossil characteristic of the Benton. These shales are underlaid by a hard blue limestone, containing *Alectyonia carinata*, which is characteristic of the Washita division. The Dakota sandstone is absent. Limestone belonging to a lower horizon of the Washita division was found, beneath which was a limestone containing a

fauna characteristic of the Fredericksburg division.

Dr. E. C. E. Lord followed Mr. Vaughan's paper on the general geologic features of the region with a petrographic description of the rocks collected. The rock types were:

1. Massive rhyolite.

1a. Rhyolite breccias.

2. Quartz-pantellerite, which was described from America for the first time.

3. Basalt.

WM. F. MORSELL.

GEOLOGICAL CONFERENCE OF HARVARD

UNIVERSITY, FEBRUARY 11, 1896.

On the Geological Work of Vortices and Eddies, by T. A. JAGGAR, JR.

A vortex occurs wherever a fluid current is retarded or deflected. The properties of such movements have been worked out mathematically by Helmholtz and others; the present writer's aim is to express in simple terms the application of their results to geology, and to demonstrate it experimentally. Mention was made of the importance of vortical movement in the study of meteorology, the flight of birds, oceanic currents, dune formation, snow drift and névé sculpture; and a series of experiments was exhibited with specially devised projection apparatus. A horizontal beam of light projected to the screen through narrow glass tanks served to show Bjerknæs' beautiful experiment with vortex rings, the actual development of ripple-drift on a sandy surface in cross-section, the growth of ripplemark and some imitative beach marks. Apparatus for bending the beam upward through glass-bottomed trays showed the gradual separation of the linear sand ridges under the influence of the ripple-forming vortices in both rippledraft and ripplemark, and attention was called to the possibility of experimentally illustrating the action of coastal eddies in building cusps.

To be published in the proceedings of the Boston Society of Natural History.

T. A. JAGGAR, JR.,
Recording Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of February 17, 1896, Dr. Adolf Alt spoke of the anatomy of the eye, and by aid of the projecting microscope exhibited

a series of axial sections representing the general structure of the eye in thirty-one species of animals, comprising two crustacea, the squid, three fish, two batrachians, two reptiles, ten birds and eleven animals.

Prof. F. E. Nipher gave an account of the Geissler and Crookes tubes and the radiant phenomena exhibited by each when used in connection with a high tension electrical current of rapid alternation, and detailed the recent discoveries of Prof. Röntgen, showing that certain of the rays so generated are capable of affecting the sensitized photographic plate through objects opaque to luminous rays. Attention was also called to the experiments of Herz and Lodge with discharges of very high tension alternating currents which showed that by the latter certain invisible rays are produced, which like the Röntgen rays, are capable of passing through opaque bodies, such as pitch, but differing in their refrangibility by such media.

One person was elected to active membership.

WILLIAM TRELEASE,
Recording Secretary.

THE WOMAN'S ANTHROPOLOGICAL SOCIETY.

The Woman's Anthropological Society, which under the presidency of Miss Alice C. Fletcher, has greatly enlarged its scope and membership, held its 138th meeting February 1st. After the usual business, the session was given over to Miss A. Tolman Smith, director of the section of psychology.

The paper of the day was by Miss Theodate L. Smith, of Clark University, subject 'The Motor Element in Memory.' The paper described in detail a series of laboratory experiments made by the writer with a view to determine the quantitative value of the motor element in the total act of memory.

Discussion of the subject was deferred to a subsequent meeting, and the remaining time was given to the problem of emotional expression which has occupied the attention of the section for several months. Brief letters were read from Profs. Melville Bell and David Bell, also from the directors of dramatic expression in leading universities of this country, setting forth their views as to the relation between the psychic and the physical agitations that make

up the emotional state. The subject was illustrated from the standpoint of dramatic art by Mrs. J. M. D. Lander, who drew a most subtle and vivid picture of 'dual personality' in the consciousness of the actor.

Miss Wescott, principal of the Western High School, closed the discussion with a summary of tests of emotional disturbance applied by means of the Kymographion under the direction of Dr. Arthur MacDonald.

From a series of graphic records showing the effects of various emotional and mental states upon the breathing, two were selected as typical, one of the nervous, the other of the lymphatic temperament. It was interesting to note that, while in the latter the registration of emotional disturbance was relatively less than in the former case, yet there was the indisputable record of such disturbance in spite of the subject's unconsciousness of the effects. Two inferences seemed justified by the series of experiments: first, that one breathes less during any effort at concentration and under a depressing emotion; second, that one breathes more under the exhilarating influences of pleasure or amusement. Two questions were suggested as the practical outcome of the experiments: First, if the tendency of education is toward repression and self-control, is it not important to supplement courses of study by exercises that foster spontaneity; second, if the child actually breathes less under close application to study, to what degree is our physical culture work correcting this deficiency?

A. CARMAN,
Secretary.

NEW BOOKS.

James Clerk Maxwell and Modern Physics. R. T. GLAZEBROOK. New York, Macmillan & Co. 1896. Pp. vi+224. \$1.25.

Vegetable Culture. ALEXANDER DEAN. London and New York, Macmillan & Co. 1896. Pp. vi+132. 35 cents.

Exercises in Physical Measurement. LOUIS W. AUSTIN, CHARLES B. THWING. Boston, Allyn & Bacon. 1896. Pp. x+198. \$1.50.

The Whence and the Whither of Man. JOHN W. TYLER. New York, Charles Scribner's Sons. 1896. Pp. xv+312. \$1.75.